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PERUVIAN FABRICS

BY

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By M. D. C. Crawford.

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INTRODUCTION

This paper is the sequel to the preceding, entitled *Peruvian Textiles.* In that paper the necessary introductory discussion left little space for consideration of the actual fabrics. This omission has been in a measure remedied in the present work. Here the discussion is almost entirely devoted to the different techniques of weaves. When it is understood that this technology is very nearly as extensive as is that of today, it will be appreciated that within reasonable limits, an exhaustive discussion of each division is impossible.

In order to establish techniques, certain fabrics have been submitted to microscopic dissection. Where it was found advisable, detailed drawings or diagrams have been made. These correspond as faithfully as possible to the fabrics under magnification. In every possible manner, these diagrams were verified, but it must be recalled that not only were the specimens too valuable for the dissection of an unlimited number, but the fineness of texture and the fragile condition must be taken into account as well. Within my knowledge, no collection of archaic fabrics was ever subjected to so rigorous a technical investigation. But this was absolutely necessary. Fabrics, especially if very fine, and often differing in technique from modern webs, can never be fully understood from surface examination, be it ever so patient.

In the following pages reference will be made to certain techniques and designs, which quite closely, and often exactly, correspond to Asiatic fabrics. Comparison of some kind or other was absolutely requisite in order to establish the significance of these weaves. The desire to clearly state the technical properties are all that such allusions mean. On any other question, such as intrusion, I am by no means qualified to write. That the mechanical resemblance is strong and even the artistic expression at least reminiscent, there can be no doubt; but this is perhaps sufficiently explained by the fact that in Asia and Peru, cotton, at least in their textile zenith, become the principal fiber.

This at first glance may sound strange to anyone looking at the handsome wool fabrics, but it will be plain when it is understood that even in these, cotton was almost always used in the warp. Of course, the character of the warp threads strongly influences the type of loom. Again, cotton fiber requires a distinct method of spinning. The fiber is very short and weak compared with wool and bast. It may be here mentioned that there is a marked similarity in the techniques of both spinning and weaving of Asia and Peru.

Not to enter into too lengthy an explanation, it may be sufficient to point out that finer threads can be made from cotton than from any fiber, except silk. Also, the nature of the fiber makes the yarn very pliable. Therefore, to avoid tangles some form of loom which can exert an even tension on warps is necessary.

The simplest form is the two-barred loom. This type prevails throughout the entire cotton area in the New World. The Hopi of today use a loom differing little, if at all, from those found in the ancient Peruvian graves. The modern rug weaver of the Orient would only need to employ heavier beams or bars to use this form.

The ancient Greeks did not use cotton; bast and wool were their fibers. Hence, we see on their pottery, single-barred, warp-weighted looms, similar in all essentials to the types used by the Chilkat Indians, the Swiss Lake Dwellers, and the inhabitants of Iceland. An apparent exception to this distribution of looms, according to fiber, may be made in the case of Egypt. Here, a people famous for their use of flax, used the two-barred loom. So far as we know, these people never used cotton. The infinite skill they achieved in flax spinning leads me to doubt if any cotton belonging to ancient times will ever be found, for bast appears always to precede the use of other fiber.

This exception is, however, only apparent. The early Nile spinners were so skilful that they made threads from flax only a little less fine than could be made from cotton, that is, taking a fair average of fineness, not the superlative cotton spinning. When such pliable warps became common, the mechanics of weaving eventually forced their invention, as it forced the users of cotton, to the two-barred type. Such a loom is clearly shown in a famous wall painting; but, the earliest, I am inclined to believe, was the single-barred warp weight type. In proof of this, it may be well to state that among very old Egyptian artifacts occur clay objects strongly resembling loom weights. These are sometimes called fish net sinkers, but their similarity to true warp weights is so pronounced as to be worthy of notice.

The textile development of pre-Inca Peru is unique in many ways; but to the student of archaeology it possesses a peculiar value. It is the world's one perfect record of the technical and artistic development of a single people. Here there is no trace of outside influence. From the simple to the complex, from the crude to the perfect, a single people have left their record in the time-defying sands. It should be of interest to students of textile art in the Old World, but its chief value is to those interested in the fabrics of the New World. For here, the baffling question of Spanish influence is absent and where doubt exists, a comparison of coarser fabrics and designs from other areas with pre-Inca technique or design may be of help.

The most recent additions to the Museum's collection of Peruvian fabrics are the Nazca and Inca collections. These were presented by Mr. A. D. Juilliard. They contain many fabrics of great technical interest as well as artistic value. They are discussed in the following text, but are of such interest as to deserve special mention.

In conclusion, I wish again to acknowledge my obligations to Mr. C. W. Mead, curator in charge of the Peruvian collections. This research was conducted in the infrequent leisure hours of commercial work and without the benefit of his scholarship and unfailing courtesy, must have dragged on indefinitely.

The subject has great fascination. I leave it with extreme reluctance. Virtually only its mechanical and technical phases have received consideration. Its artistic merit, its influence on other arts, and a thorough comparison with similar developments in other parts of the New and Old World, all suggest further research.

June, 1916.

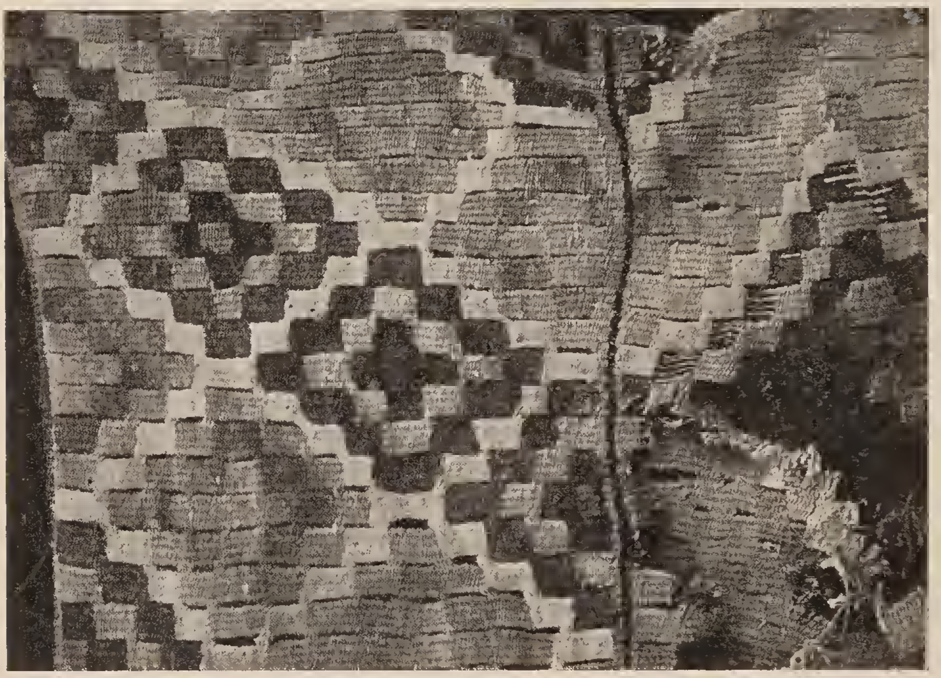

Fig. 1 (B–798). Tapestry showing intentional openings left between differently colored areas ending in parallel warps. The slits are left with a decorative intention.

TAPESTRY.

In tapestry, Peru reached its highest textile development. The harmony of color, the beauty and fastness of dyes, and the perfection of spinning and weaving, place these fabrics in a class by themselves not only as compared to the other textiles of this land, but as regards those of any other people. The patience and skill indicated in the finest pieces passes belief. Many contain nearly three hundred weft yarns to each inch. In the first paper of this series a web containing 260–280 weft yarns to the inch was analyzed. It was impossible to count the weft in this fabric with the testing lens ordinarily used in textile analyses. It was necessary to clamp an inch of cloth on the platform of a dissecting microscope and pick off the weft yarn with a needle. The operation took three and one half hours. The specimen subjected to this severe treatment was in a fragmentary condition, and the destruction of so small a piece was justified in the interest of exact information. When a standard of comparison was thus obtained, it was unnecessary to mutilate the perfect specimens on exhibition. Sufficiently accurate counts could be made by comparing the texture of this specimen under magnification with each piece.

The question naturally arises, how long under the most favorable conditions would it take an expert weaver to finish such a web? It is a rather common belief that the explanation of such fineness is to be found in an almost limitless amount of time at the disposal of the weaver. The fallacy of such a supposition must be apparent to anyone at all familiar with the manifest duties incident to savage or barbarous conditions of life. The only accurate measure of comparison available is the fact that the weavers of the famous Gobelin tapestry finish in a year of work only one square meter of cloth. Perhaps the fact that this is a subsidized industry, in which the workers by no means exert themselves, may account for this slowness. Much greater production is achieved in commercial institutions making tapestry a little less perfect, but the illustration is chosen as the best known and finest example in existence. These works of art are very coarse in texture as compared to Peruvian tapestry, and if we assume an equal amount of skill in weaving both, we must of course admit that the latter took a much greater amount of time. But this assumption is by no means necessary. Hand loom weaving in Europe even at its zenith never reached the development achieved in either Asia or Peru and today has sunk to very limited proportions. The weaver's pay, as compared with other trades, is so low as to offer little inducement to the best mechanics. There is,

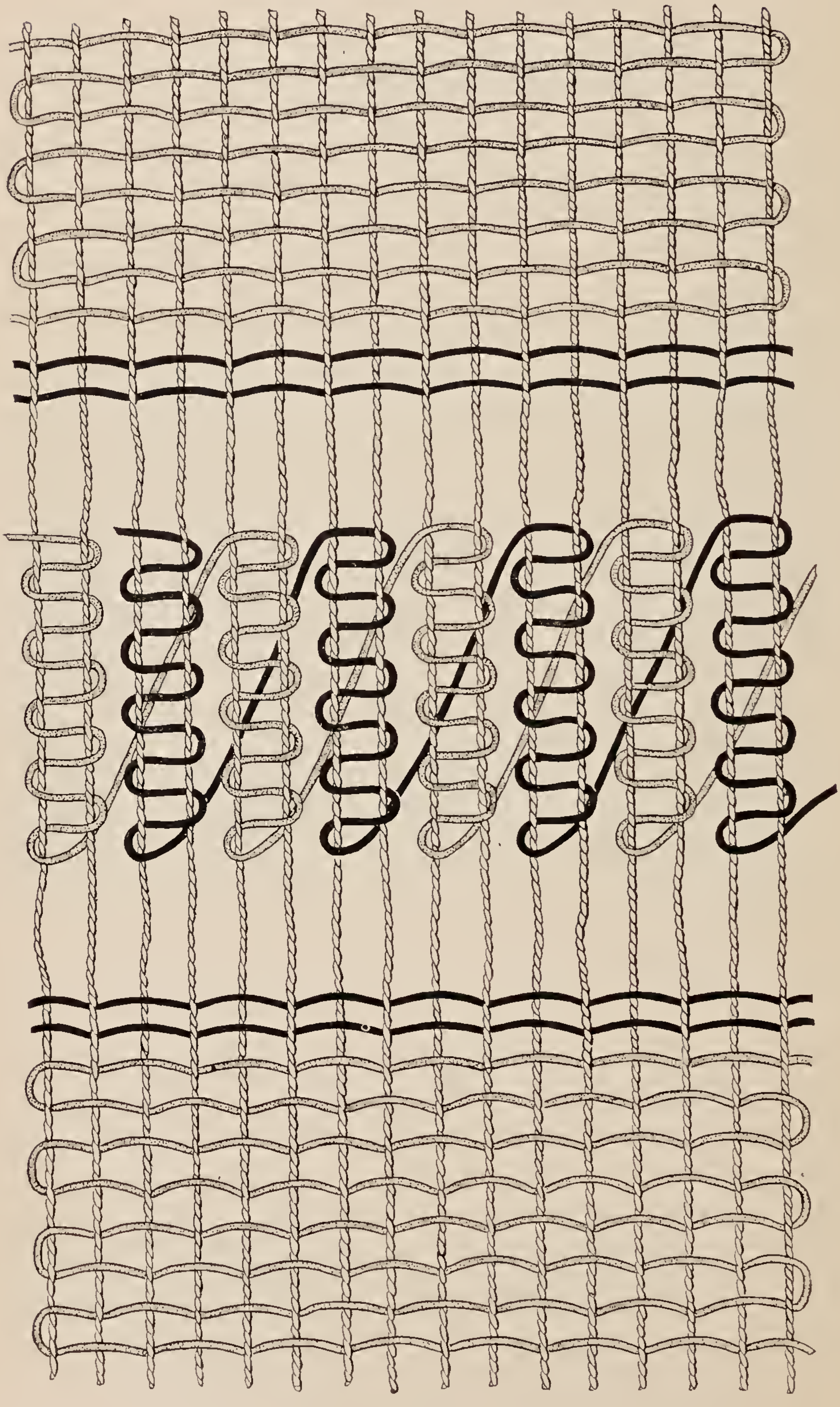

Fig. 2 (B–811). Method of making a Leno Stripe in Tapestry.

therefore, no great class of people engaged in this craft from which the French Government can draw the most skilful and most rapid artisans for even a subsidized industry. In Peru almost every woman was a textile worker, thoroughly understanding every detail, and no doubt the most skilful of these were elected to serve in the convents which were in a sense great textile institutions. There can be little question that such surroundings greatly increased individual skill, and that these weavers worked with a dexterity and rapidity as amazing in its way as are the wonderful results of their labor. However, it must be freely admitted that under the most favorable conditions the construction of these webs must have taken considerable time.

The theory of tapestry weaving is simplicity itself. It is merely a kind of darning of weft over or under tightly stretched warps. Only one element, the weft, requires manipulation. Once the warps are stretched in the loom they need never be disturbed. Tapestry weaving precedes the most primitive shedding devices. Of course, after the discovery or invention of heald rods, tapestries were woven on looms containing this archaic labor-saving device, but even after this introduction, figured webs were woven without its aid. In fact, the principle involved in tapestry weaving, precedes the loom itself, for when the first savage intertwined pliable boughs with the rigid upright stakes to form a fish weir, the resulting texture was a kind of tapestry, since tapestry is a fabric in which weft crosses over or under equal warp units and is inserted in such a manner as to completely cover warps when beaten up. Today the term is always applied to decorative webs, but as this description can be as well applied to them and also include certain unfigured cloths from Peru, the definition has been limited to mechanical peculiarities.

Design was produced in this class of weave by the contrast of varying colored areas darned on the warp according to the above rule. Therefore, it must be obvious that each field of color, however small, forms in a sense, a separate fabric (Fig. 1). To make the design, as many bobbins of weft were required as there were shades in the design (see tapestry belt loom, this volume, Fig. 13, p. 84). In weaving, the back of the fabric was toward the weaver. She picked up the bobbin containing the shade of weft yarn to cover the first few warps on one side of the loom, laced them in, took a second color, and so on, until the entire width of the warps was covered. Then the same operation was performed from the other side. In this manner, the designs were built up, a pick of weft at a time, not each formed separately and the space between then filled in as in modern Navajo blankets. In the best Peruvian tapestry, the wefts are almost perfectly parallel, however often the color may change. Unless the methods above described were pursued, this would be impossible. It must be obvious, therefore, that when two areas of color come in contact on parallel warps, there would be a slit in the fabric unless some means were employed to close it up. Sometimes short slits were purposely left open to accentuate design (Fig. 1); sometimes they were avoided by having colors come in contrast on lines running at oblique angles to the warp. The most interesting technique in Peruvian tapestry webs is displayed in the manner in which these characteristic slits were closed. I have therefore thought it best to refer to the diagram of this technique in my first paper.

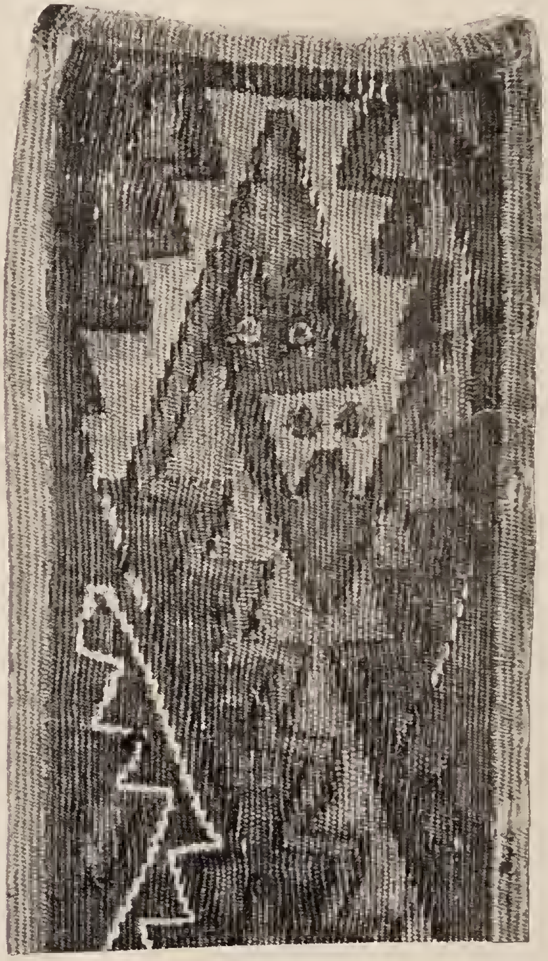

Fig. 3 (B-9650). Portion of a Tapestry Belt.

It is as impossible to give an idea of the fineness of these webs, as it is to convey a conception of the beauty of the color combinations. Certain webs are so perfect that it would be impossible to add an extra weft yarn without puckering the cloth. Weaving errors were never detected no mat-

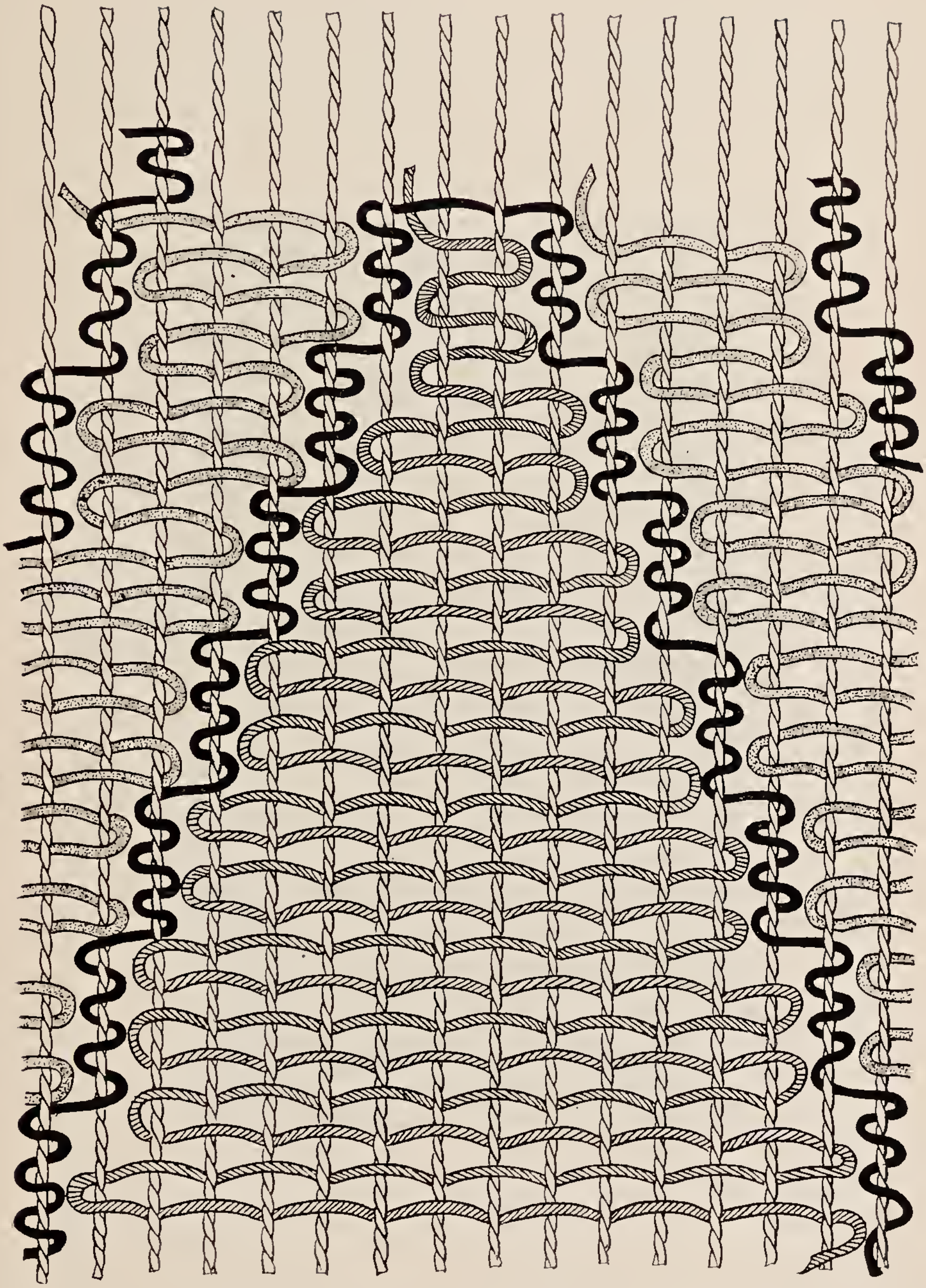

Fig. 4 (B–9650). Method of outlining the Figures with Black Weft wrapped around the Warp.

ter how complicated the design, each square inch was found to contain the same number of warp and weft. Mention has been made of the use of bobbins in weaving. Each color required a separate bobbin. When this color was not needed in a certain area of the web, it was allowed to rest on the stretched warps. When it was again required, it was carried to the next area to be covered. Certain fragments of webs in the collection show these loose hanging threads connecting areas of the same shade or color. But in most fabrics these ends have been cut off and so carefully tucked in that it is impossible to determine which is the face and which the reverse of the fabric. The backs of the most beautiful Gobelin tapestries are a mass of tangled threads and the slits have been closed, except in the Morris tapestries, by rough sewing. Contrast this with the exquisite care taken in finishing the tapestry of the old Peruvians. In Coptic tapestries

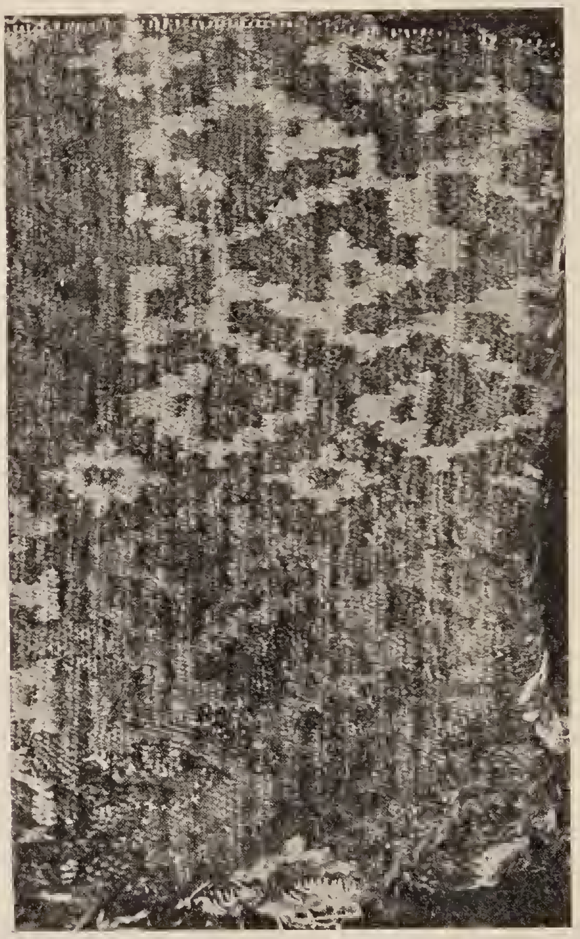

Fig. 5 (41.0–1152). Tapestry from Nazca in which all Wefts interlock.

very often borders were taken from one fabric and sewed on another. This was never done in Peru. Occasionally, borders that ran parallel to the warps of the fabric were attached by an extra thread, but never actually sewed on the surface of the fabric. If the Peruvians made a practice of using the borders after the other, less durable parts of the web had been worn out, we might understand their finishing their tapestries on both sides, and also account for their double-faced bobbin-weaves. In the absence of any proof of this, we must attribute this exquisite finish characteristic of the finest webs, to their craft pride. No one can long examine these wonderful fabrics without feeling the sense of beauty and the great degree of skill displayed which raises their best weaving from a craft to the status of an art.

Besides the technical skill shown in closing slits, to which reference has been made, there are many skilful methods of varying the monotonous effect of their simple weave. Fig. 2 is an example of a leno or open stripe produced in tapestry.

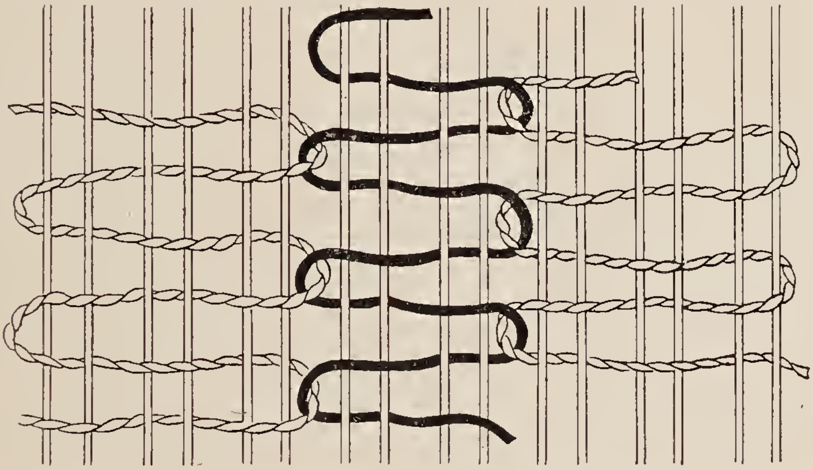

Fig. 6 (41.0–1152). Diagram showing Interlocking Weft.

Fig. 3 is an illustration of a fine tapestry belt. Fig. 4 shows the diagram of the technique. The triangular figures have been outlined by wrapping warps with a colored weft. The diagram represents a small portion of perhaps three-eighths of an inch. A fine example of the wrapped warp technique is in the collection but not illustrated in this paper. This is a beautiful belt, containing a most interesting design in which the pure geometric motives are combined with symbolic figures in a wonderfully balanced color scheme. The black outlines of certain of the units have been formed by the aid of a single intervening warp covered with a black yarn.

Certain tapestries contain examples of eccentric weft, that is, weft that crosses the warps at other than right angles. There is no intention of correcting slight imperfections of texture, but an evident purpose to vary the monotony of this weave. The insertion of this weft occurs between two figures and sometimes as an outline to certain small elements of design. It may have been inserted with a needle.

Besides the filling in of spaces between figures by the needle, there are a few fragments of belts in which almost all the wefts run at oblique angles to the warp. When these fabrics are held up to the light they do not show the transparent outline which commonly appears between other tapestry figures. In Dr. Holmes' monograph on Peruvian tapestries, he comments on this peculiarity. The skilful application of eccentric wefting allows a gradual tapering of the figures so that the slits incidental to contrasting color areas are reduced to a minimum. Even these minute openings were closed where necessary by the aid of actual needle insertion. In these pieces the designs lose their accustomed rectilinear outline and are formed from curved lines on plain, closely woven cloths. Great skill has been shown in inserting the weft, where necessary, at oblique angles to the warp. The resulting fabrics are as solid as plain web.

Figs. 5 and 6 show an unusual refinement in the insertion of weft. Between each color a black weft forming a line in the texture intervenes. The colored weft interlocks with this as in Fig. 6. On an average there are eight such interlockings to the inch and as there are seventy-two weft picks per inch, this makes 576 spots where weft loops together in a square inch.

No large fabrics containing this technique have been discovered. The method of weaving must have been very tedious and possibly there was a deviation from the practice of building up design the width of a pick of weft at a time. That is, the separate units may have been darned in and the slight opening subsequently closed with the needle.

The space devoted to the discussion of the technique of tapestry weaving has been taken merely to indicate the refinement to which the art was carried. All these little expedients whether they had for an objective the perfection of weave as in the skilful closing of slits, or in the warp wrapping and leno stripe, some relief from the monotony of the weave, simply go to prove to what refinement this simple method of textile expression was carried. Perhaps these deviations may have had an added value as suggesting certain other styles of weave. But the great appeal of these fabrics and their chief interest is to art rather than mechanics. They represent the highest form of artistic expression of a people not lacking in a fine appreciation of abstract beauty.

In the varied range of design which runs from the crude delineation of symbolical creation to the purest form of geometric art, and even where design figures were distorted by the limits of superstition, the color scheme was harmonious. When we approach that phase of their artistic development where the units of design were employed purely as convenient forms for the massing of colors, we find a knowledge of color values as fine as the world has ever seen. Even the finest examples of cashmere shawls and Persian rugs can show no more beautiful color schemes. The mechanical limits of their art denying them a proper expression in the delineation of form, they expressed their artistic powers in the blending of colors. To this as a natural corollary, they added a fine sense of proportion. The designers of modern textiles, such as upholstery materials, carpets, and hangings, should find in these old fabrics a priceless inspiration. All the arts of decoration, requiring the use of strong colors, might enjoy an equal profit from their study. It would have a unique value as a purely American source of art and give to our industry a certain needed individuality.

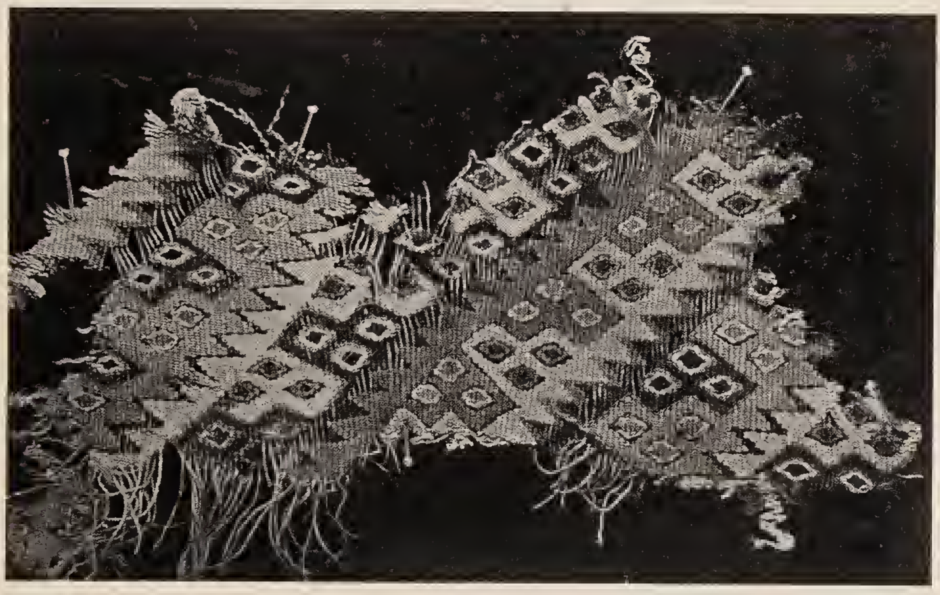

Fig. 7. Tapestry showing the Conventional use of Cat Heads, Pachacamac.

The Museum collection contains a number of very beautiful tapestry ponchos. These garments are in almost perfect condition, especially as regards the condition of the dyes. They are well known to most students of archaeology and are illustrated here as examples of two phases of the art development of Peru. The first is an Inca piece, discovered in a stone chest on the island of Titicaca (Fig. 8). Other Inca specimens show not only greater technical skill but a higher art value. This one is typical of what may be termed primitive textile art. That is, the design has been developed with attention rather to the portrayal of the incidental portions than as a connected scheme of ornamentation. The separate panels are ornamented with animal figures and the border contains a series of human forms of highly martial character. A further interest attaches to the fact that these later figures are partially formed from silver tinsel yarn. These yarns are formed by twisting thin silver ribbons about a core of wool yarn and are the same in character as the tinsel yarn used in the famous Polonaise rugs.

The color scheme, while excellent, is perhaps a trifle strong, while the design plan is distinctly barbarous. In the second poncho, the combination of color and the proportion of design is perfect. This poncho comes from Tiahuanaco and is typical of the best work of pre-Inca Peru (Fig. 9). In texture, it is perhaps not quite as fine as the standard of excellence established by B-1225, but even here the difference is very slight. The proportion between the V-shaped neck piece and the border is perfect. The simplicity, directness, and purity of the geometric figures suggests the love of form of ancient Greece.

The warps of both these pieces are of three-ply cotton and the weft of two-ply vicuña.

I leave the discussion of this class of textiles with extreme reluctance. It is so rich in artistic suggestion and interest as to deserve special consideration, perhaps at some future date. It bears worthy comparison with Coptic and Byzantine workmanship and with the later silk tapestry of China. It is as high in artistic and mechanical merit and more deserving of study since it represents the complete development of a single people and the most comprehensive collection of prehistoric art in existence.

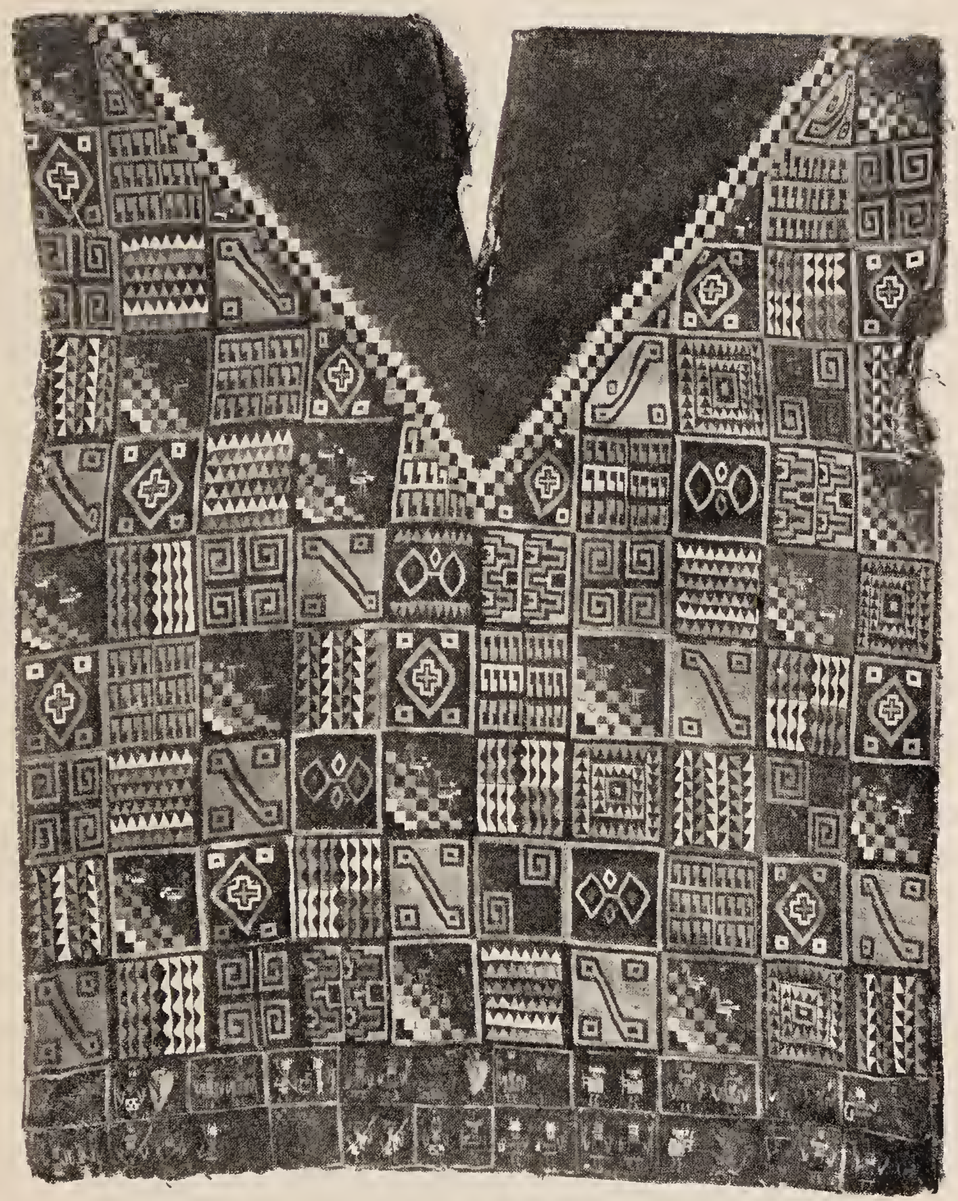

Fig. 8 (B-1500). Inca Poncho found in a Stone Chest on the Island of Titicaca, containing a Border in which Silver Tinsel Yarns occur.

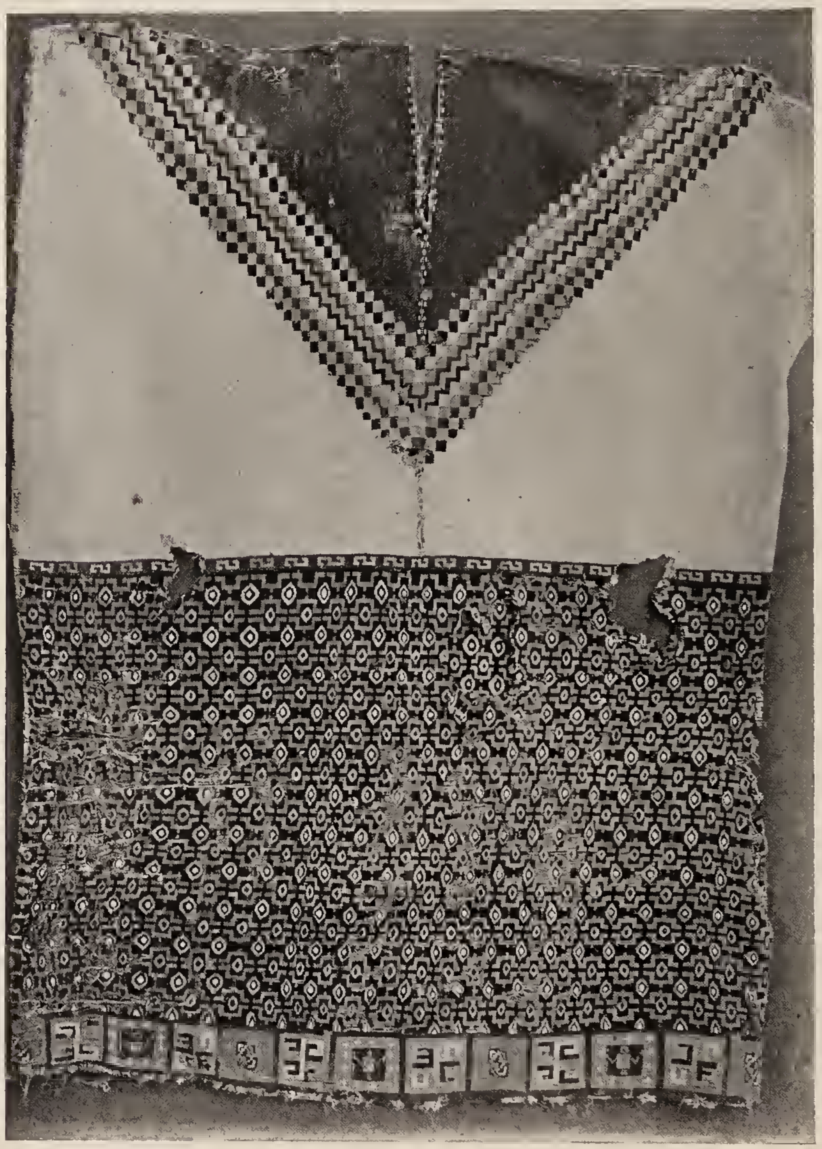

Fig. 9 (B-1506). Tapestry Poncho from Tiahuanaco, perhaps the handsomest fabric in the collection.

BROCADE AND EMBROIDERY.

In the first paper of the series, certain fabrics really brocaded were assumed to be embroidered. This misapprehension was the natural result of the great similarity between the two methods among the ancients. Embroidery is the addition of ornamental yarn or yarns to an already woven fabric. It is inserted by the aid of a needle or needle-like instrument, and need not cross the other yarns at right angles, but may be applied at any angle, at the caprice of the artist. Many fabrics in the collection take full advantage of this freedom. So strong was the influence of the textile art upon this people, that many of the finest embroidered webs voluntarily followed the rectilinear outline produced by the crossing of thread at right angles, despite the liberty inherent in this class of texture.

Brocading is the addition of an extra ornamental weft or wefts, inserted during the actual weaving of the fabric. These decorative units must follow the angular restrictions of the plain weft, and are generally of larger diameter and softer twist and are inserted in a slacker manner, so that the beating up may cause them to cover the warp and weft of the basic fabric. They are generally inserted in such sheds as to cover or go over a much greater number of warps than they go under. One fabric examined contained just twice the number of warps as plain weft and the brocade yarns were caught under every other end. Here was plainly a kind of basic fabric especially woven for this nature of design. In certain fabrics the brocade weft covers unequal warp groups as in bobbin-weave. However, some follow the same sheds as the ordinary weft.

The difficulty of determining which was embroidery resembling brocade and which the true brocade was solved by two partially woven fabrics still in the loom (Fig. 10) which were a part of the collection recently presented to the Museum by Mr. A. D. Juilliard. These fabrics were about a quarter finished and had evidently been buried with their weavers. They contained very intricate designs. Since they still show three-quarters of the warp unpicked, the decoration must have been applied during the formation of the web and they are plainly brocade.

In the light of the facts revealed by these partially woven webs, some rules may be outlined, which will aid in the proper classification of these so nearly allied techniques. However, owing to the great skill of these workers, it was quite possible for them to make embroidery which closely imitated brocade. Therefore, the rules are to be accepted as subject to qualification. Another confusing detail is the combination of these two styles in a single figure. Bearing these points in mind, the following explanation will be reasonably exact. If the decorative yarns are plainly sewed on, that is, have been carried completely through the fabric, and if stitches are occasionally taken at other than right angles to the warp, it is embroidery. If the decorative yarn runs parallel to the weft of the basic fabric, and therefore at right angles to warp, and if it is only caught under warps, it is brocade. The reverse side of brocade will only show a very faint trace of the surface color where the decorative weft goes under an end of warp. Embroidery sometimes has the same peculiarity, though hardly to such a degree. If the decorated weft is carried from selvage to selvage, it is almost certain to be brocade, although many true brocades are woven in modified medallion form.

This technique is very common in these old fabrics. The diagram shown in Fig. 11 is an expression of unusual refinement in which the very order of shedding warps is made a means of creating design. Fig. 12 shows the actual fabric. In the first paper, this was erroneously referred to as self-decorated embroidery. Examination of the diagram will show that the warp and the basic weft cross over and under each other in the regular order of simple interlacings. But the decorative weft is picked in double and goes over five warp ends, then under one and over five again, each successive pick beginning one warp nearer the left hand selvage, the order is then reversed until a diamond-shaped figure is formed. It will be observed in the illustration that a second figure or concentric diamond is formed by the appearance on the surface of the section of the warps under which the decorative weft is picked.

A similar technique appears in which a very heavy brocade yarn has been used on a comparatively light fabric. The central portion of this shawl-like garment is a light voile-like fabric of cotton. On the diagonal corners brocade decoration appears in which a series of diamond figures have been formed by the raised warps as in the diagram.

The writer is familiar with no other textiles made by hand which contain so manifest an evidence of loom control. A close parallel is found in the tinsel brocade fabrics of Asia which are made on treadle looms. A fine example of this was shown in the recent textile exhibit at the Metropolitan Museum of Art. It must be evident that to accomplish this result a great amount of careful mathematical calculation and great care were indispensable.

The borders of certain Ica shawls display a very skilful technique (Fig. 13). The object has been to obtain a fabric in which the embroidery yarn completely covers the basic fabric. For this purpose a very loose web was

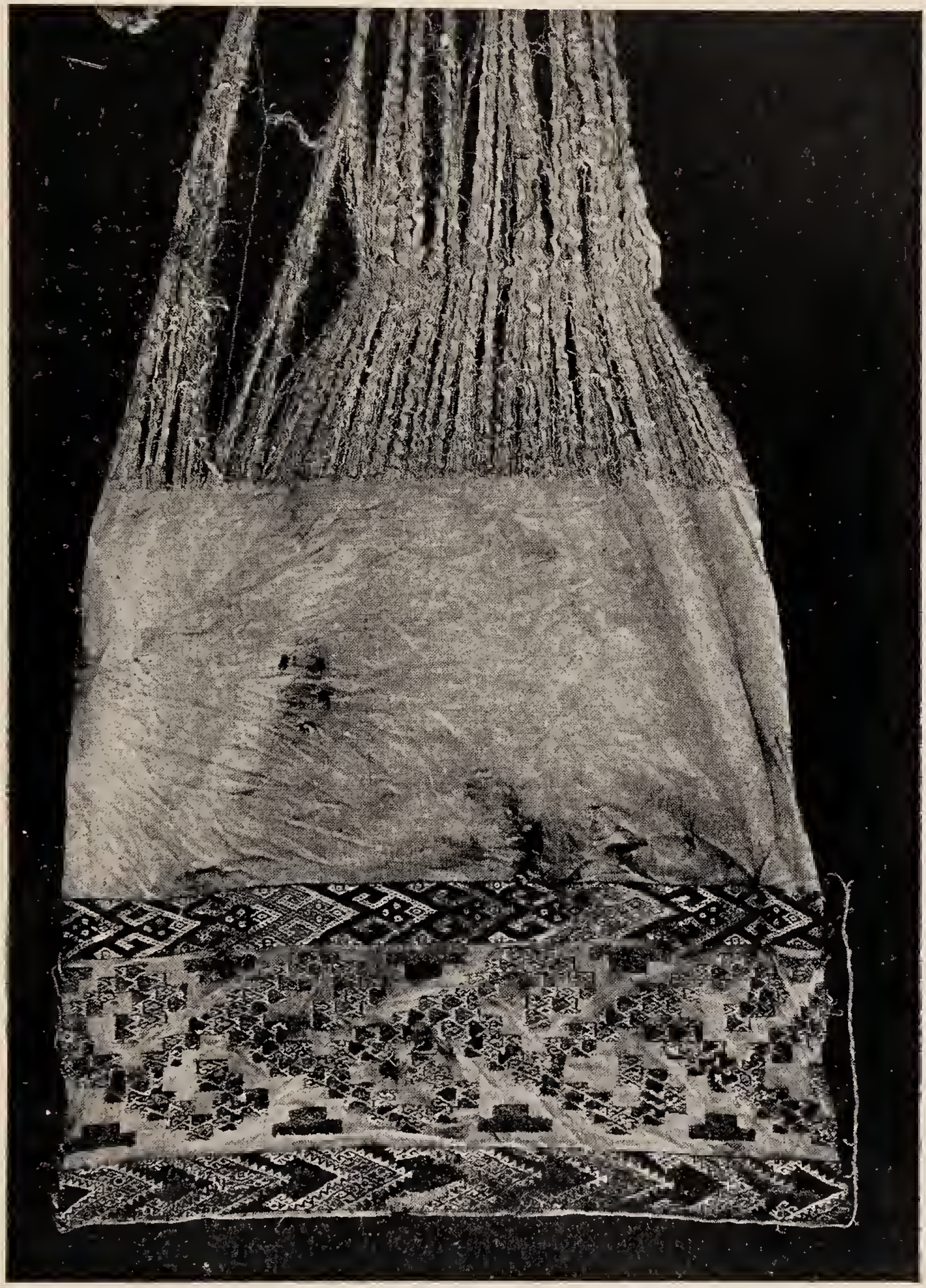

Fig. 10 (41.0–1560). Partially woven Web from Ica, containing Brocaded Design.

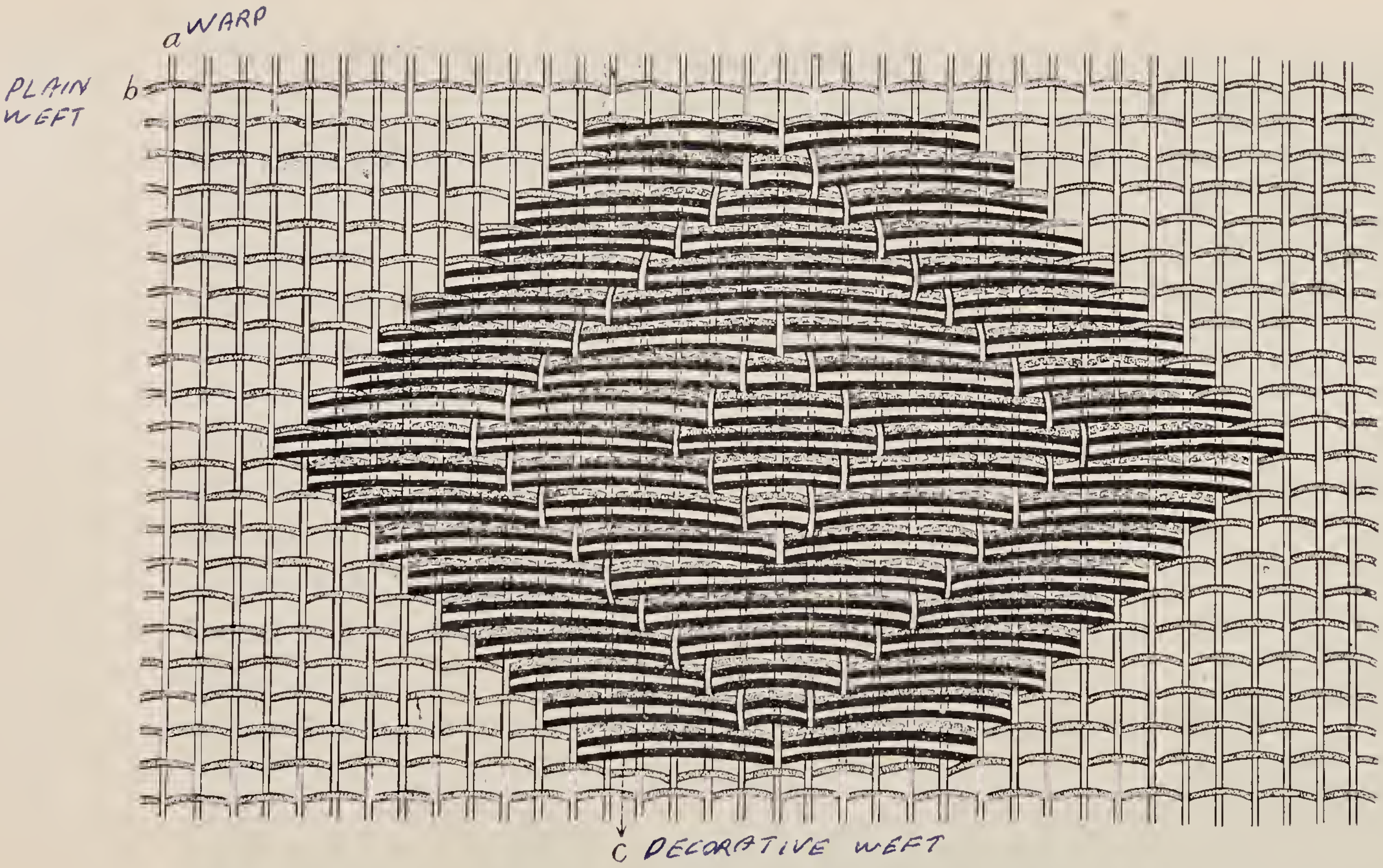

Fig. 11. Brocade in which the order of shedding warps produces an additional design, *a*, warp; *b*, plain weft; *c*, decorative weft. No plain weft can be seen under the decorative weft, but the stippled line shows where it runs under the decoration.

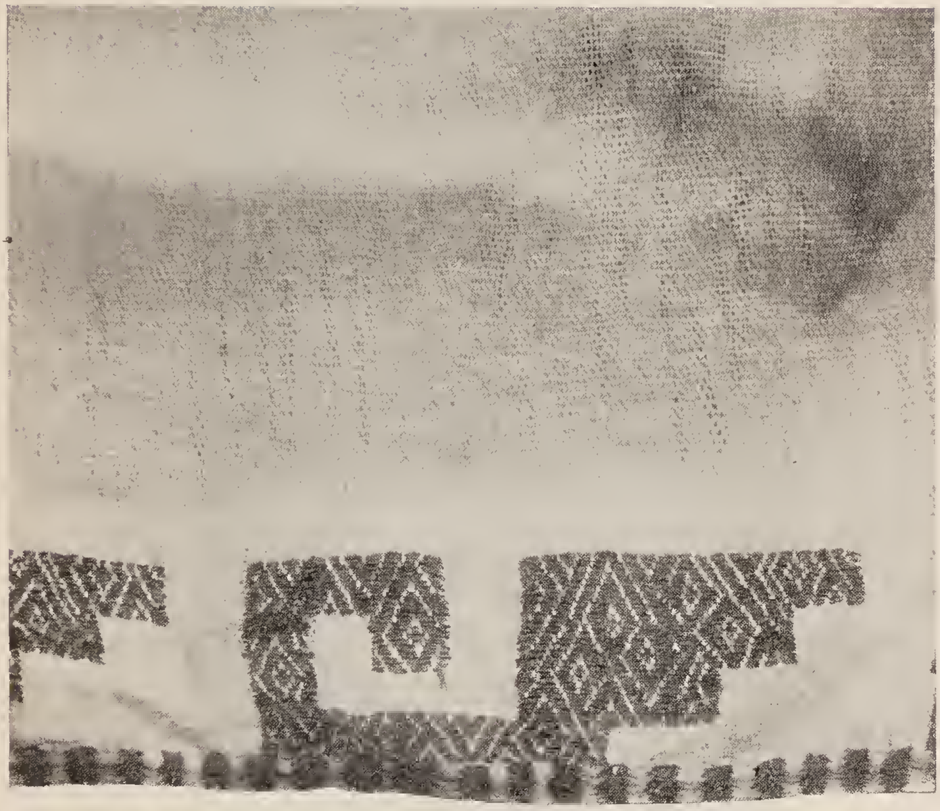

Fig. 12 (B-4334). Brocade Design in which the Order of Shedding the Warps produces a Secondary Design.

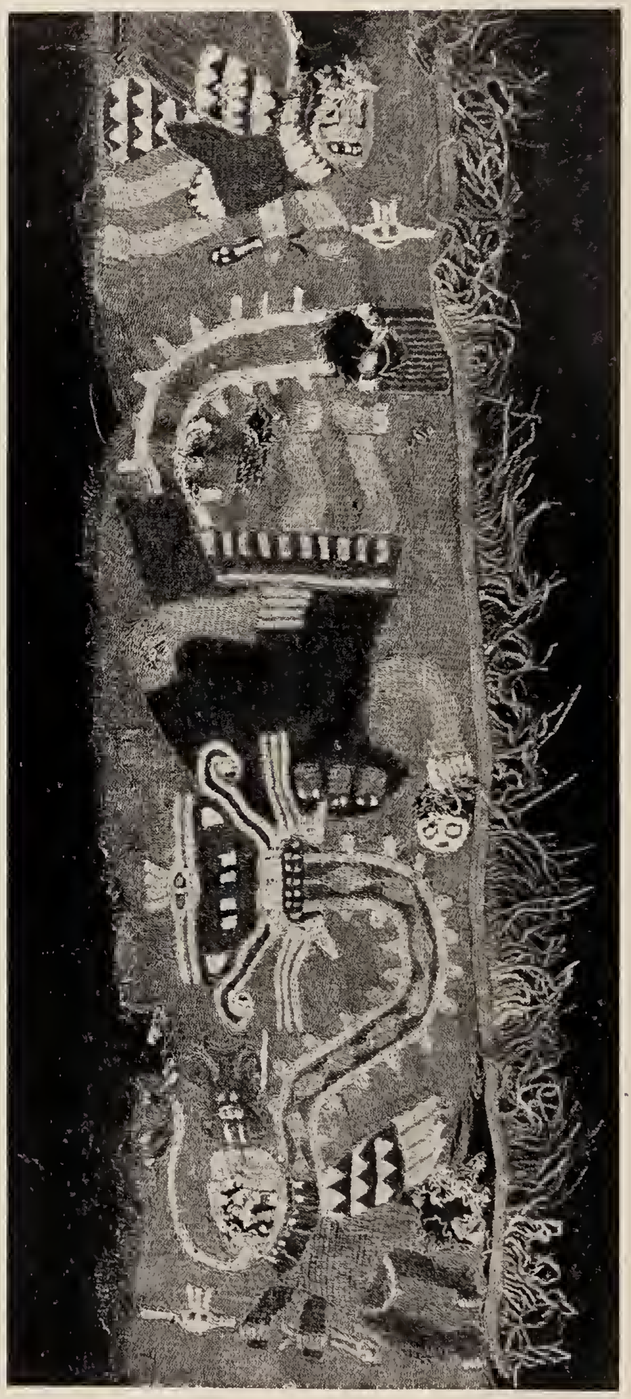

Fig. 13 (41.0–1526). Embroidered Border to Ica Shawl. The embroidered stitch completely covers a very loose basic fabric.

first formed. Apparently the wefts were locked at the selvage into the main part of the shawl. The specimens are so tender as to make this a very delicate matter to be certain of without injuring valuable exhibition pieces. The peculiar way in which the decorative yarn is laced a full turn about pairs of the warp or weft (Fig. 14) forms a ridge-like surface on the back of the cloth. The direction of these ribs changes with the altered direction of the embroidered yarn on the surface of the web. Where this change occurs, the embroidery weft has been laced about pairs of warp instead of weft. The looseness of the basic fabric permitted this change to be accomplished by the tightly looped embroidery yarn. A reference to the diagram will at once make this clear. Fig. 15 is an Ica shawl decorated in this manner.

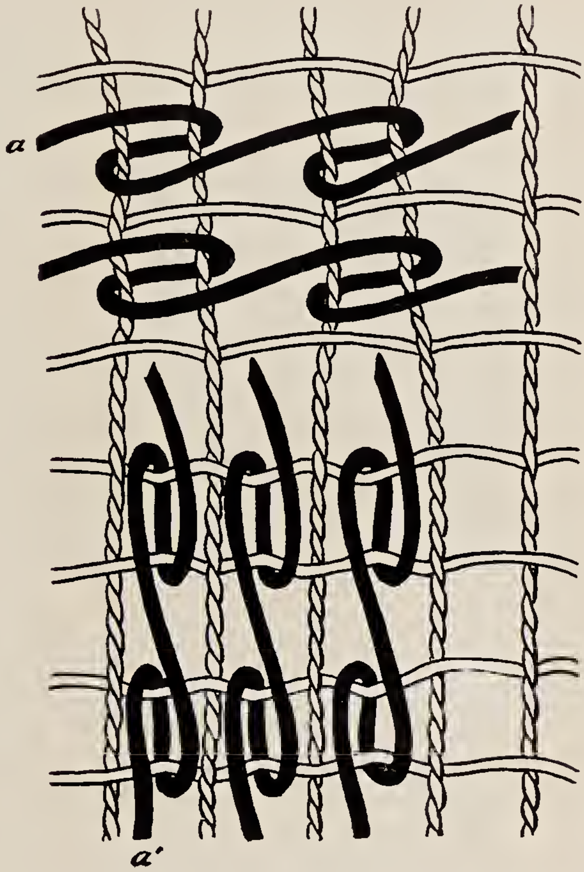

Fig. 14. Diagram of the Technique of Embroidered Ica Shawl showing manner in which Weft is locked around pairs of either Warp or Weft, according to the direction required by the design.

The Ica shawls above referred to contain a combination of both gauze and embroidery. Their discussion has been reserved for the chapter on gauze.

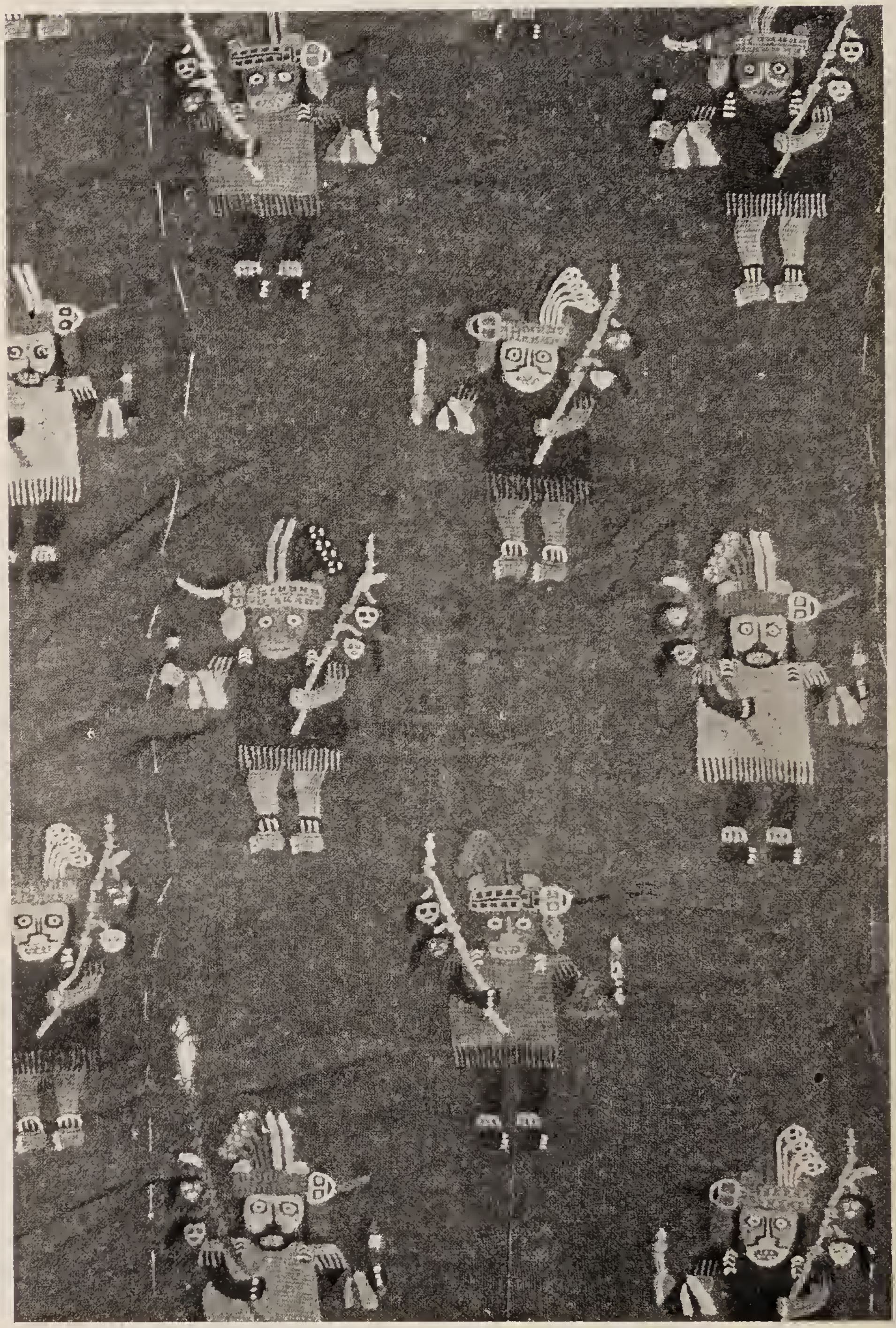

Fig. 15 (B–4334). Panel of Ica Shawl embroidered on Gauze, embroidered Yarn inserted as in Fig. 14.

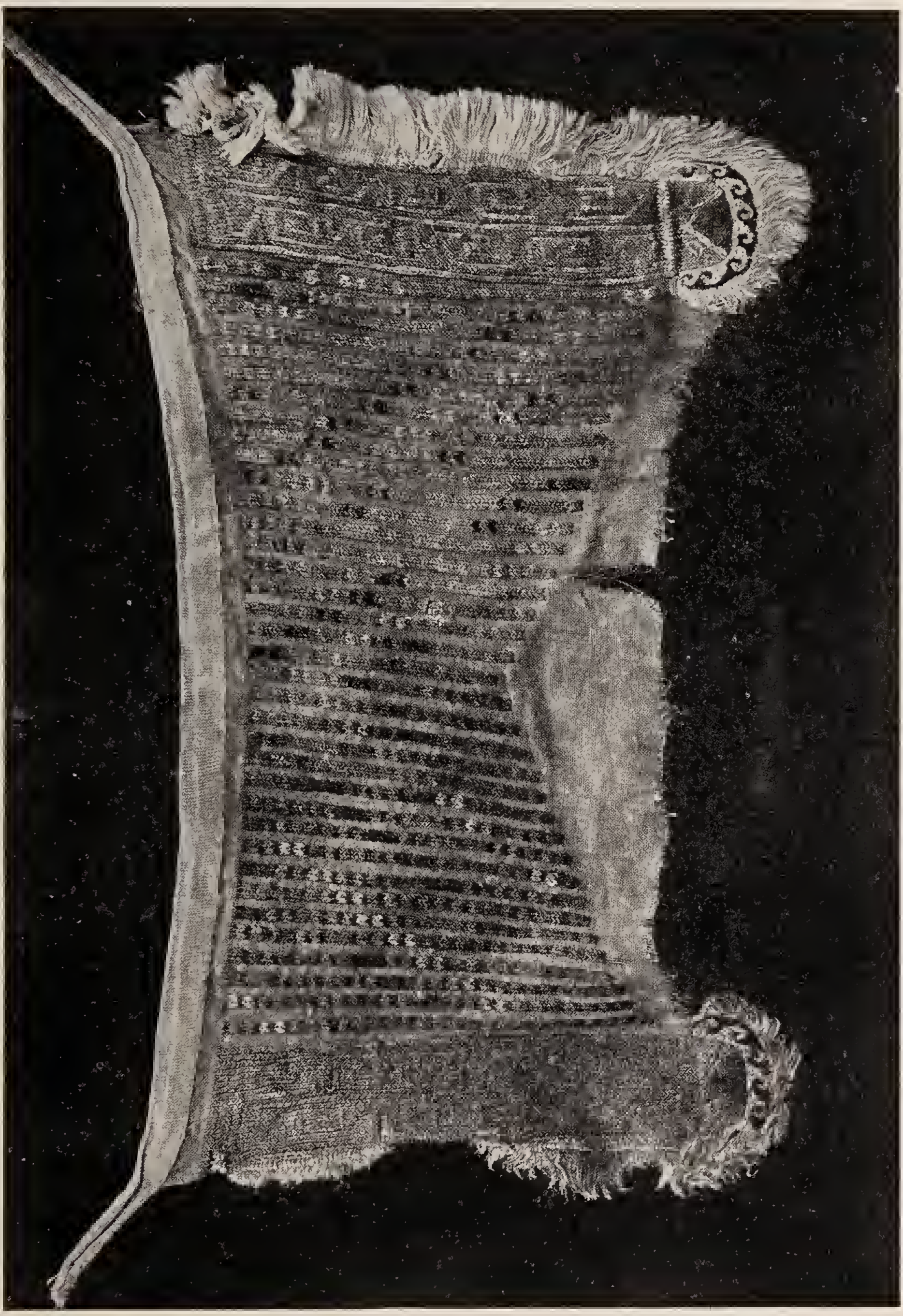

Fig. 16 (B–8685). Chain Stitch Embroidery similar to Moorish Rugs.

Fig. 16 represents an embroidered loin cloth ornamented with chain stitch. The technique is similar to that of Moorish rugs.

In Fig. 17 is shown a remarkable veil. The basic fabric is a very light cotton voile. The yarns are extremely fine and the degree of twist greatly in excess of modern spinning. The embroidery yarn is two-ply, dyed cotton except the yellow, which is vicuña. The workmanship is superb. The rather heavy figures do not pull the light texture at all. The only other fabrics of this character of a similar fineness and artistic value were the wonderful seventeenth century muslins of Dacca.

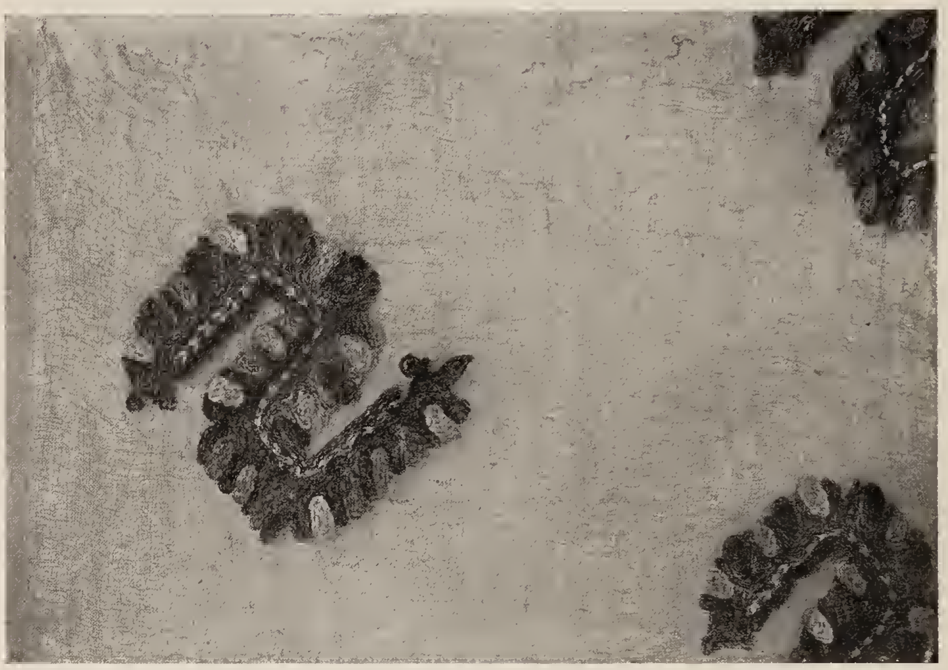

Fig. 17 (B–S13). Embroidered Veil.

DOUBLE CLOTH.

Double cloth or two beam weave, is a fabric containing two sets of warp and two sets of weft which are combined into a single fabric in the loom. Weaving is done on both sides of the loom and at intervals regulated by the nature of the design; certain warps are raised and picked with their weft and the corresponding warps on the surface lowered and picked with their weft. This produces masses of contrasting color on both surfaces, assuming that the two sets of yarns are of different colors. By carefully arranging the order in which this crossing of warps occurred, it was possible to produce almost any design. The designs would be exactly reversed in color; the figures on the reverse side would be the same color as the warp and weft of the surface fabric; the figure on the surface would be the same color as the warp and weft of the reverse fabric.

This technique not only produced design but by the crossing of the two sets of yarn, also locked the separate fabrics into a single web.

It may be that in other parts of the world where double cloth weaving was practised, the object was to obtain a warm, heavy web without the use of coarse yarn, but in Peru no such object was sought. Here this method of design production appears mostly in bags and in the great number of charms buried with the dead where warmth certainly was no consideration. Once its technique was developed this method was actually found to be a very simple means of producing design and for this reason recommended itself to the old weavers.

The fabric selected for illustration is not especially fine in texture, but it represents a very common form of this technique and its open weave and simplicity of design made it easy to analyze (Fig. 18). It is a little charm about $3\frac{3}{4}$ inches long by two inches in width. The central inch and a half consists of a double cloth design of a conventionalized fish. At either end is a narrow length of basket weave in which the two sets of warps appear picked with a single weft. This is not double cloth. Barely enough weft is used in them to hold the fabric together. These ends were folded back of the double cloth and sewed in the form of a small cushion.

The construction of the cloth is as follows (this refers to the double cloth portion): —

Surface fabric warps, 24 two-ply cotton dyed brown, per inch
" " weft, 24 two-ply alpaca dyed red, per inch
Reverse fabric warp, 24 two-ply white cotton, per inch
" " weft, 24 two-ply white cotton, per inch

Basket weave portion: —

48 warps, 24 brown, 24 white, per inch
12 weft, white cotton, per inch

The ends of the fabric appear cut. At the ends of all cloths which are as long as the loom, it is customary to find the warps looped around a loom string. It seems unlikely that the old weavers would set up a fresh warp for such a short fabric, therefore I assume that a number of these charms were woven on a single set of warps. Weft could be changed at any time in the operation. Certain of these interesting objects have double cloth designs on both sides, others have broad weft stripes on the back, but the form illustrated (Fig. 18) is the most common.

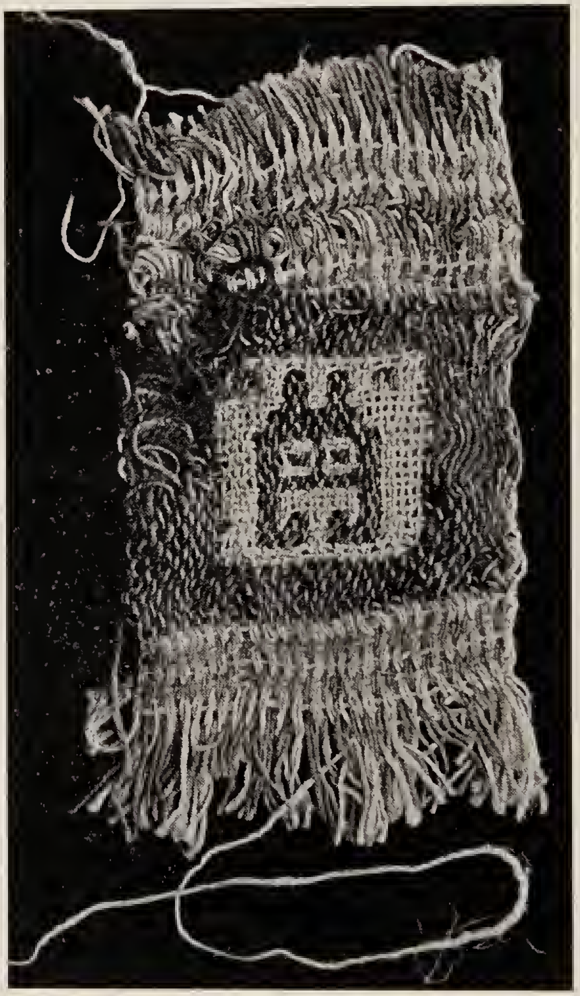

Fig. 18. Small Double Cloth Charm with Fish Head Design.

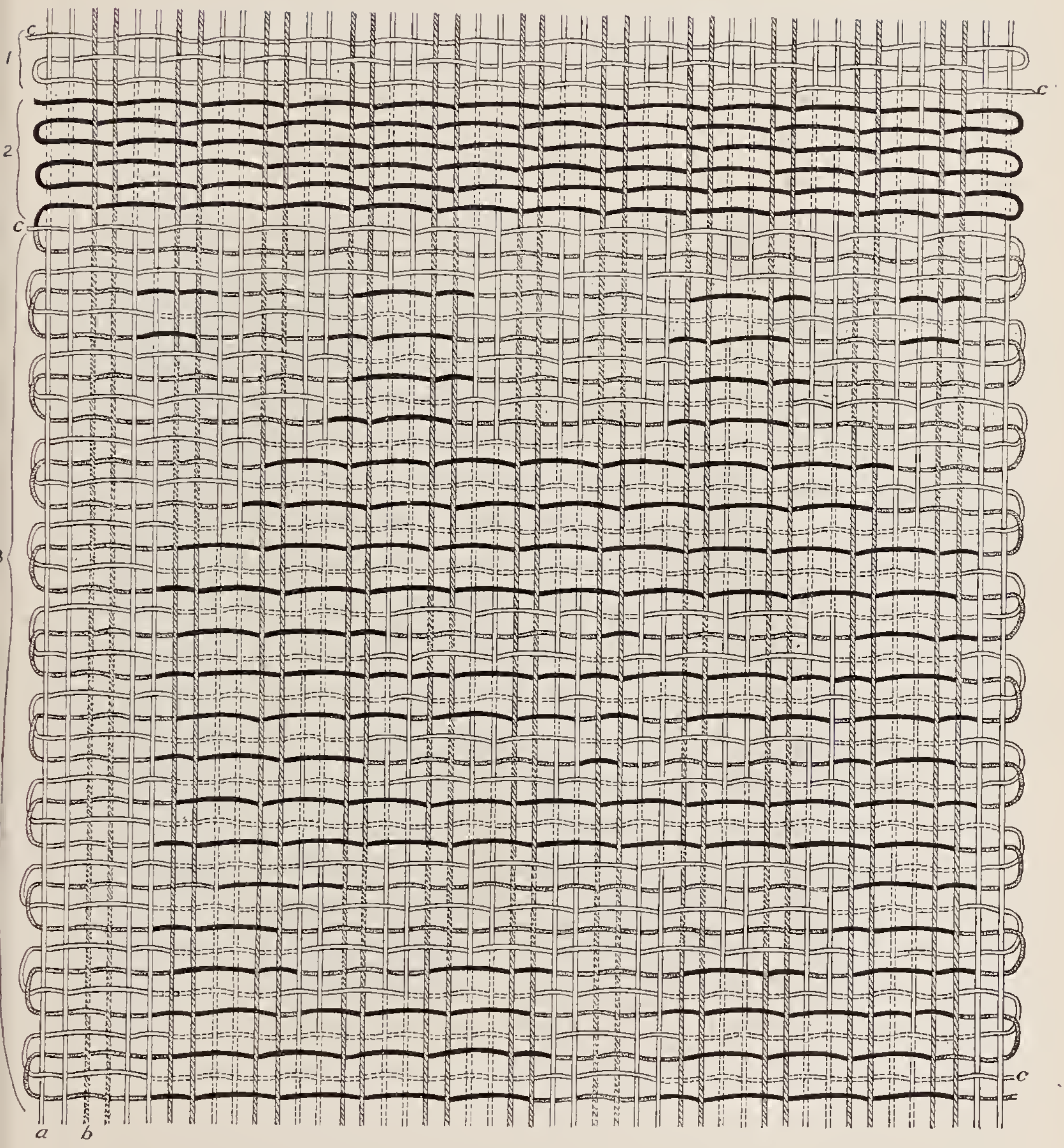

Fig. 19. Diagram of Fish Head Double Cloth Charm shown in Fig. 18.

Let me call the reader's attention to the photograph of the actual cloth. It will be observed that just below and above the white square containing the design there is a broad band of red which ends where the basket weave begins. The diagram shows that the white warps which belong to the reverse fabric are unpicked with weft under this band. This made the fabric pliable for bending at this point.

The diagram (Fig. 19) is divided into three parts: the first includes the basket weave portion; second, that portion which contains a fabric woven from the combination of brown warp and red weft; and third, the portion which is in the area of the double cloth and contains both sets of warp and weft appearing and disappearing as the nature of the design requires.

In number one the warps have been combined in groups of two brown, alternating with two white and picked loosely with a white weft. All the brown warps were raised in one shed, all the white in the alternate shed. The weft has small decorative influence. The method of weaving produced stripes parallel to weft, formed by two colors of warp appearing and disappearing.

Let us now consider the diagram (Fig. 19). In it are indicated four distinct threads. *a* represents white warp. Where this is intended to show on the surface it appears as a plain line. Where it appears on the reverse it is illustrated with dotted lines. *b* represents brown warps; where it occurs on the surface, it is shown by cross hatched lines; on the reverse by dotted lines. *c* represents white weft. When it appears on the surface it is shown by plain lines; on the reverse by dotted lines. *d* represents red weft. On the surface it is shown by a black line, on the reverse by stipling.

Portion one of the fabric has been described. Portion two consists of a plain weave of the brown warps, *b*, with red weft, *d*, for six picks. The white unpicked warps, *a*, hang at the back and are indicated by dotted lines. At the edge of portion three, *b* disappears from the surface, as is indicated by the dotted lines, and *a* and *c* appear for two picks as the change from dotted to solid lines indicates. This change from reverse to surface appearance is quite obvious in the diagram, once the significance of the lines is understood. A continuous repetition of the sequence would be monotonous.

All that it is necessary to understand is that the diagram represents only the white square containing the fish design, the red line over it, and a small fragment of the basket weave which is folded back and sewed when the charm is complete. In the graves, these little cushions often contained bits of cotton, seeds, pebbles, or seaweed.

There is a specimen on exhibition, much finer, both artistically and technically. The design is a Greek fret and in each space surrounded by the hook are conventional cat-like figures alternating in colors. The narrow border resembles the graceful Hellenic meander. If the symbolical feline were removed, the entire design might have appeared on a vase dug up in the Aegean Islands. If such had been its origin, it would long since have served as an example of the love of beauty supposed to be peculiar to that portion of the globe. Two shades of brown were used, both dyed cotton. Each fabric contains 40 warp and 40 weft per inch or 160 picks and ends to the square inch of double cloth. The yarns are two-ply and, needless to say, very well spun.

Fig. 20 is the finest technical example of this class in the Museum's collection. It is a medium-sized coca leaf bag. The yarns are two-ply cotton, very well spun. The colors are white and brown and the designs composed of a series of small geometric figures arranged in a pleasing manner. There are 48 warp and 48 weft in each fabric, or 192 picks and ends to the square inch.

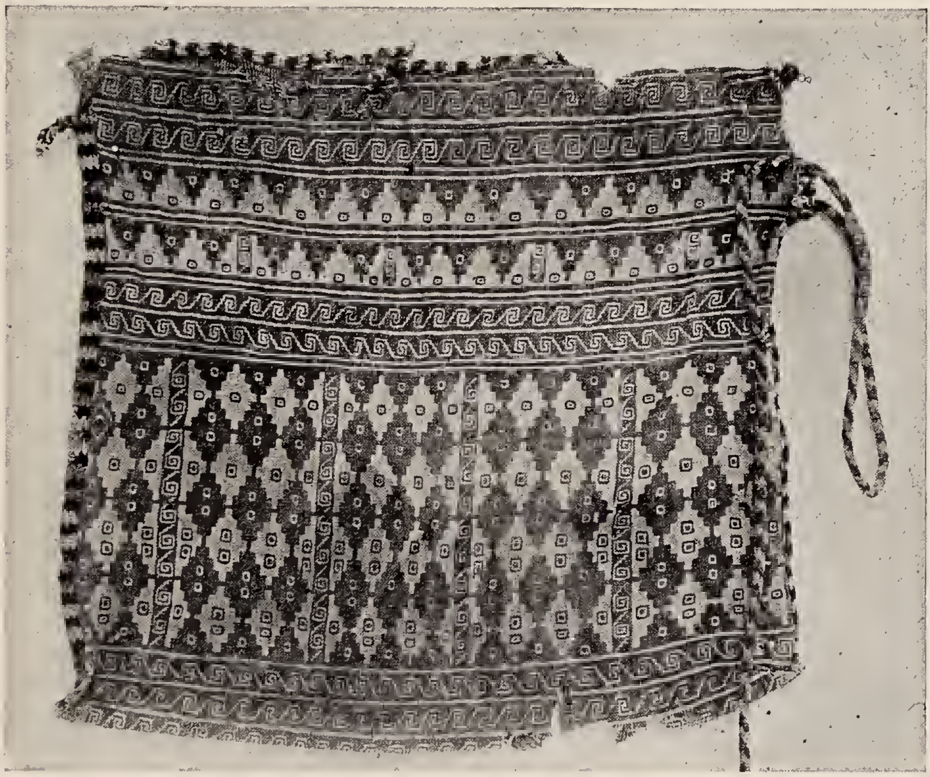

Fig. 20 (B–4600). Finest Example of Double Cloth Technique in the Collection.

It is natural to expect to find on this kind of loom at least four heald rods: two for the warps of the surface fabric and two for the warps of the reverse fabric. However, this is not indispensable, as pointed out in my first paper, as shedding, especially in the coarser fabrics, could be done with the weave dagger aided by the round bits of cane so often found with the buried looms. Their functions, it will be remembered were to keep the repeating sheds when once formed, intact, so as to avoid needless recounting of warp groups by the weaver.

B-4541 is one of those composite fabrics decorated with two or more distinct methods of textile ornamentation so common in fabrics from this country. The upper portion consists of broad brown and white stripes. The lower portion consists of a double cloth, in which the warps in the stripes become the warps in the separate fabrics. In order to make the stripes very distinct the warps are in groups of two and a very fine single-ply cotton weft (about No. 150) is used. When the double cloth section is reached the warps are still treated in units of two, but a larger single weft is used.

Generalities are very dangerous when applied to an art so ancient and so complex as textiles, but the temptation to speculate on the origin of this ingenious technique is too strong to be altogether resisted. The writer's lack of sufficient knowledge of basketry permits him only to suggest that many if not all weaving tricks originated in this interesting craft. Certainly a sufficiently large number of examples might be cited to form a basis for such a theory.

Putting this question aside for the time being, it is certain that some forms of textiles naturally suggest others to skilful weavers. Perhaps the desire to produce tapestry effects led to much of this innovation. One feature of tapestry is that design is formed by combining solid color figures. The use of colored warps and wefts in making plaids soon resulted in combinations of the same shades of these two elements in order to form solid masses of color as an adjunct to design. The white lozenges formed by an application of double cloth weave in Fig. 35 are an example of this. From the occasional use of such a technique as an aid to decoration, to its application throughout an entire web, is not a difficult mental development to follow. So it can be safely assumed that the use of colored warps and wefts in plain ginghams led to the complicated weaving of double cloth.

Double cloth technique has a rather wide distribution. It is very common and highly developed among the Huichol. There is evidence of its existence among the prehistoric Cliff-Dwellers of the Southwest and also a possible reference to its application by the old Choctaw. A few very rare Navajo blankets are thus woven.

GAUZE.

The name gauze was derived from an Asiatic city to which this weave was supposed to be peculiar. Fabrics of this class are today often referred to as lace-cloth; that is, they are woven fabrics which resemble lace. Perhaps the old weavers had this in mind when the technique was invented; a rapid way to produce a substitute for the tedious knitting of the former. However this may be, it afforded them a method of making a light, open web which was very desirable in a hot climate and the peculiar technique locked warp and weft in open meshes that would not pull.

This fabric is woven on modern looms by the use of a half or doup heddle in addition to the other harnesses; but its construction on a hand loom required no special attachment. The principle of gauze weaving is that adjoining warps or groups of warps are twisted one half turn about each other and the crosses made secure by the insertion of a weft pick or picks. If this order maintains throughout, the result will be a plain gauze as illustrated in Fig. 21. It will be observed in the diagram (Fig. 21) that the warps contained in each gauze pair are differently shaded. This does not denote different colors or material, but explains the nature of the half turn.

In Peru this technique was carried to a remarkable degree of complexity. Not only were plain gauzes of great fineness and most excellent workmanship woven, but by skilful modifications many fancy webs were constructed. Fig. 22 shows how warp stripes have been incorporated in such a fabric, by twisting together three pairs of warps at stated intervals. Weft stripes were made by omitting the gauze technique for sixteen picks of weft and picking this portion in the ordinary manner (Fig. 22b).

Fig. 23 is a fancy lace-like fabric, either a shawl or veil in which design has been produced by varying the warp groups which are subjected to the gauze turns. The photograph shows a simple geometric figure and also in one corner the conventionalized figure of a cat.

A very ancient form of embroidery still practised among the Italian peasants has gauze for a basic fabric. It is known as *buratto*. Gauze makes an ideal cloth for this purpose, since the weave is composed of even and open squares, which permit the decorative yarn to be easily applied and each stitch to be of about equal length. There is a poncho on exhibition in the Museum which has a narrow border of gauze containing embroidered design which is so even as to suggest tapestry. The gauze twist may be seen in the diagonal spaces between the figures.

In each part of Peru so far investigated nearly all types of weave appear, but in every locality some particular class predominates. This is quite natural and a similar condition exists today among the hand weavers of the Orient. A recent addition to the Museum collection acquired through the generosity of Mr. A. D. Juilliard exhibits a very remarkable degree of skill in *buratto* embroidery (Fig. 25). Fig. 24 shows a diagram of the gauze basis of this technique. A part of this collection consists of nine large shawl-like garments from Ica, Peru, in almost perfect condition. They are covered with a repetition of one figure in varying and beautiful color combinations. Between these figures a plain, rather loose, woven fabric of wool appears. The figures themselves completely cover the portion of fabric on which they appear, but in a few places age has destroyed the colored yarns, and under the embroidery, the plain weave has been changed to gauze. This accounts for the evenness of the stitches and for the ease with which this is maintained, regardless of what angle the

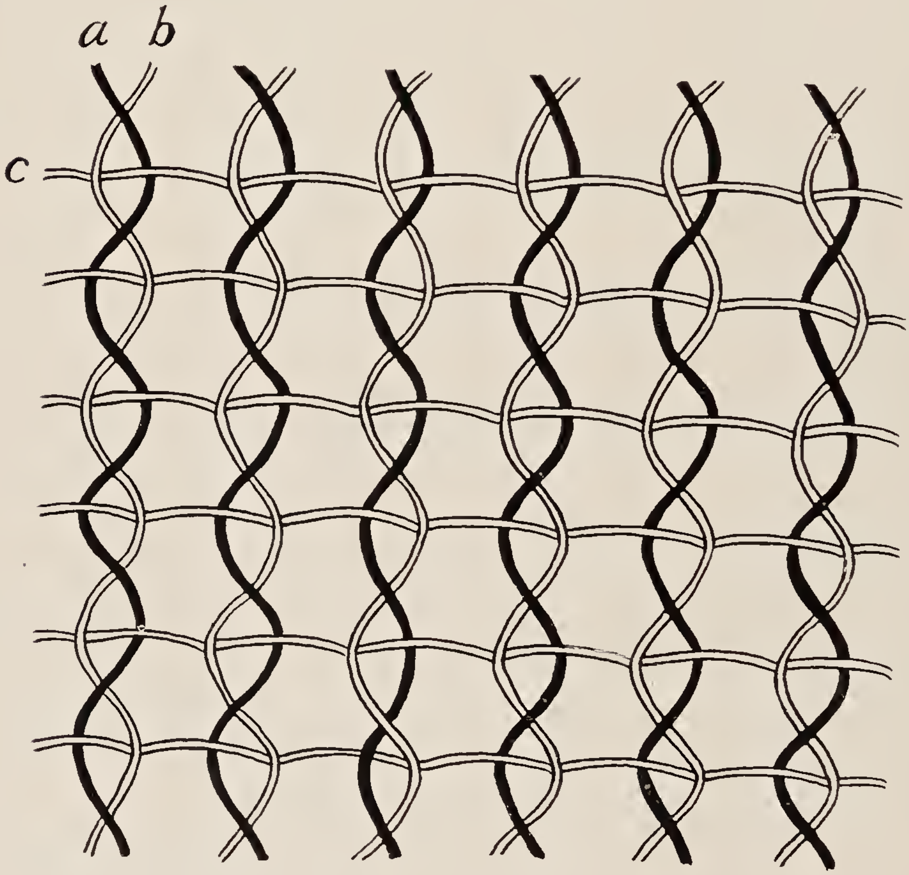

Fig. 21. Plain Gauze Technique: *a*, one warp; *b*, alternate warp; *c*, weft.

needle had to go. Reference to the diagram will show this quite plainly (Fig. 24).

No doubt the method of weaving gauze on a hand loom lay in twisting the warps with the aid of the spindle point. As mentioned above, this is very simple. How such an idea occurred is not quite so obvious. Of all fabrics, except possibly bobbin-weave, this was the last one would expect to find originating on so simple a loom. These techniques seemed so well adapted to the peculiarities of a treadle loom, that this origin was never suspected as coming from the more primitive loom.

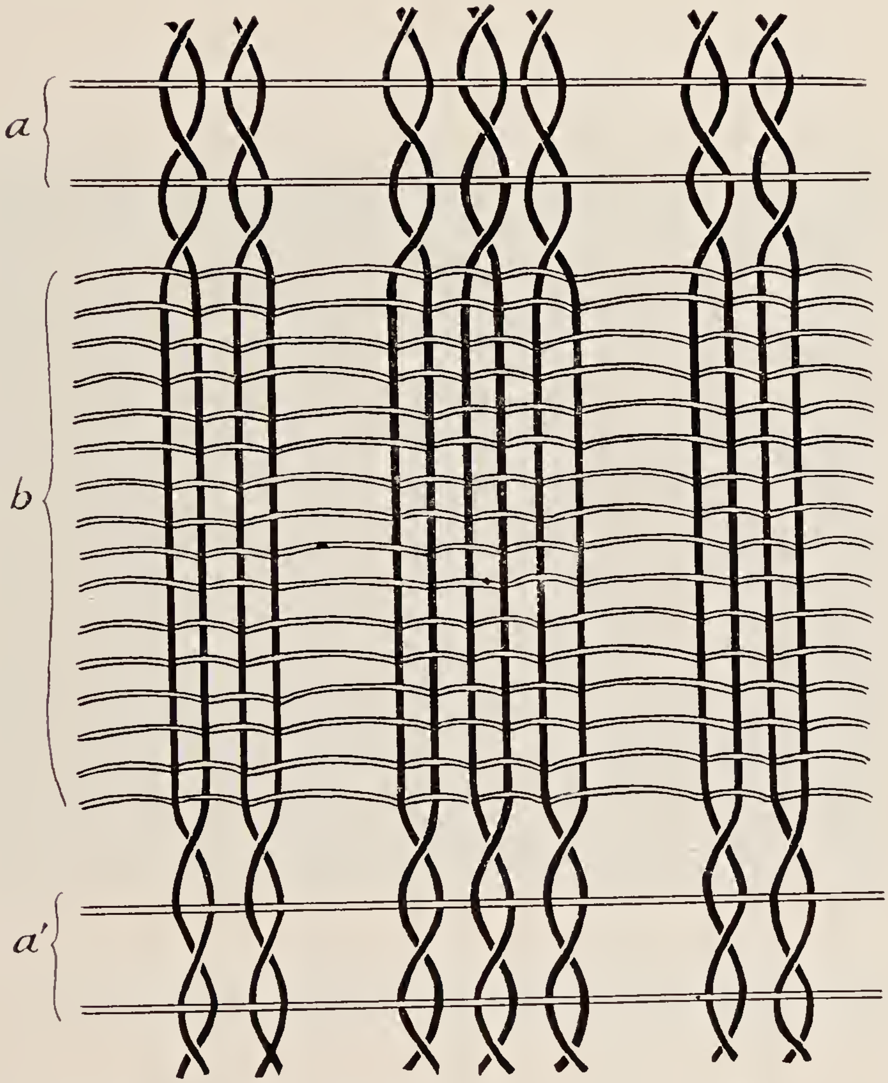

Fig. 22 (B–4336). Gauze containing Stripes, both in Warp and Weft, very similar to a modern technique.

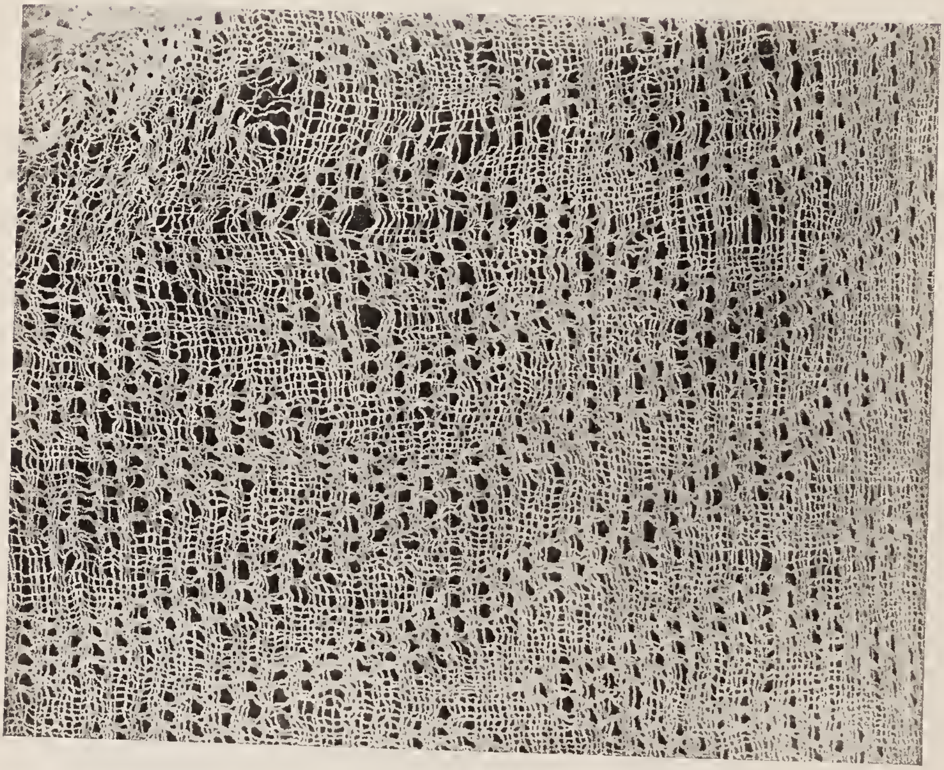

Fig. 23 (B–4070). Figured Gauze in which the Design is created by arranging new Groups of Warps in the Gauze Technique.

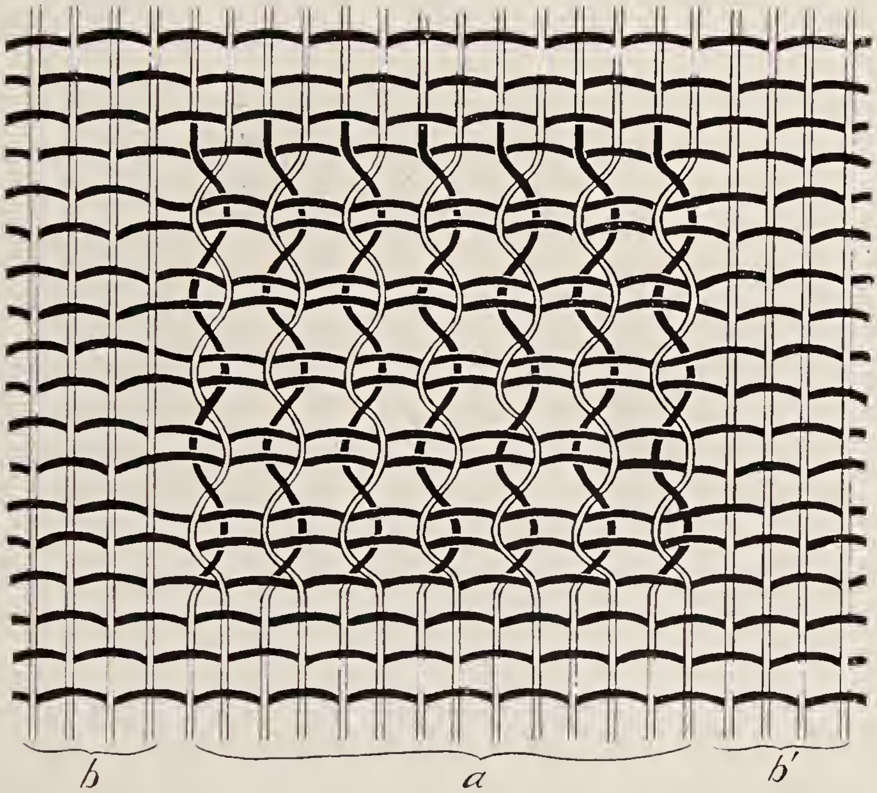

Fig. 24. Technique of Basis for Embroidery of Ica Shawls. This differs somewhat from the border shown in Fig. 15 as in that the basis of the embroidery is a gauze technique. *a*, area in which the plain weave changes to gauze; *b*, *b*,′ plain weave of the fabric outside of the embroidered area. The gauze area is completely covered by the decorative yarn.

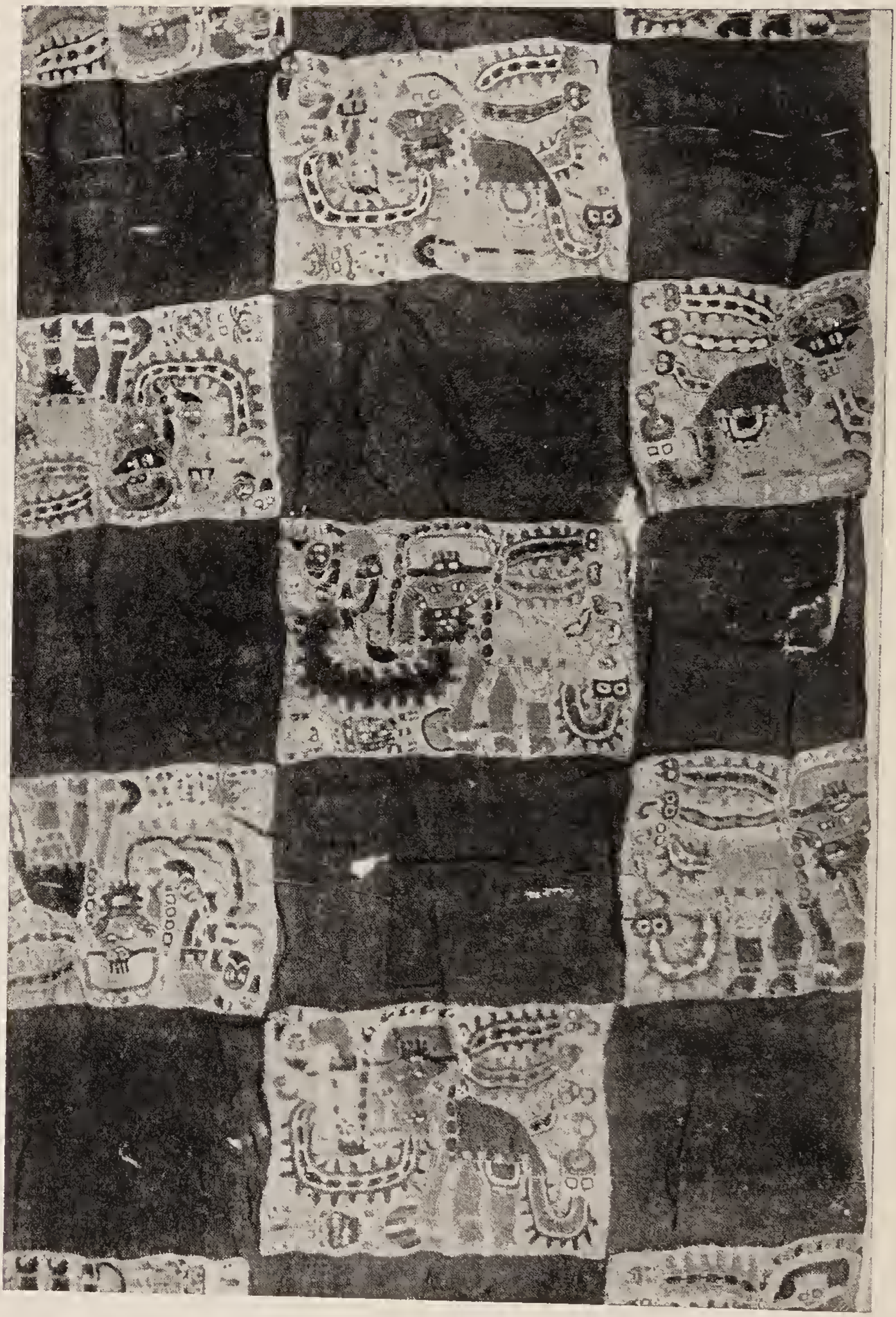

Fig. 25 (41.0–1507). Embroidered Shawl in which a single Unit of Design is repeated in varying color combinations. The undecorated part of the shawl is a plain weave, but the embroidered figures have a basic fabric of gauze as is shown in Fig. 24.

BOBBIN-WEAVE OR TRUE FANCY WEAVING.

The term bobbin-weave was adopted in my first paper to distinguish this method from other Peruvian techniques rather than to give a clear idea of its relation to textiles in general. It resembles modern Jacquard figuring from the fact that the weft crosses through irregular sheds, or over and under arbitrary groups of warp to produce design. In this respect it differs from tapestry where the sheds are always equal. In another and more important detail it differs from figured tapestry in that each color of weft appearing and disappearing necessarily makes the complete traverse of the entire warp. At least two colors are required in this style of weaving. Design depending on the proportion of each color appears in a given area. In some fabrics so decorated a certain design was repeated in squares or oblongs across the warp, but in varying color combinations. Where the colors changed, the new weft was looped into the old. This is only an apparent exception to the rule of a continuous weft as each looped weft may be regarded technically as continuous, or better, each combination of color as a separate fabric. Its similarity to tapestry lies in the fact that weft was inserted in a slack manner which allowed for a beating up as close as in tapestry and which in the finer pieces completely covers up warp. It will be recalled that it owes its name to the assumption that the tapestry bobbin was the implement used to insert weft (this volume, p. 88).

There are two distinct types of this method of decoration found in Peru. In the simpler, rougher method, the weft was inserted with the idea of producing design on the surface only. See border of bird design in Fig. 35. The reverse was a jumble of loose hanging yarns forming no clear design. The weaver caused it to appear when design was required on the surface and then carried it across the unpicked warp until design again called for its appearance. Individual skill is as evident in this as other techniques. Specimens vary in this respect from coarse fabrics up to those possessing considerable technical and artistic merit. In neither particular, however, does it equal the class about to be considered. In this class of technique appear some of the finest of Peruvian fabrics, second only in design, workmanship, and grade of yarn to their most exquisite tapestries.

Both sides of these fabrics are finished. The same design appears on the surface as on the back, except that the proportion of the colors is exactly reversed. This description would seem to fit double cloth, but the most cursory examination will show that unlike double cloth, these fabrics have only a single set of warps and that weft interlaces with equal groups of warp.

B-5917 was the example chosen for diagram (Fig. 26). It is an intermediate specimen as far as fineness goes, but the marked contrast of color and clear design outline made it excellent for illustration and the comparatively small number of picks and ends made its analysis more certain. The method of determining its structure was as follows: The warp and weft were counted with a testing glass; the nature of the fiber determined with a microscope. Then the weft was carefully cut between two warps, for the distance of about half an inch at the end of the figure to be diagrammed. Lines were then drawn indicating the number of warps covered, and as each pick of weft was carefully withdrawn, its position over and under the warps was carefully noted. The diagram illustrates this exactly and shows the combination of warp and weft necessary to produce one of the bird figures in the photograph. It would be quite possible to show this design in a modern mill draft except that weft is picked much slacker than possible on a power loom and for this reason warp does not show.

This fabric was the border to a plain woven fabric, three warps of which were combined to form one warp for the border. In the diagram (Fig. 27) the warps are drawn as single, for clearness. There are two narrow stripes of blue separated by one of brown tapestry weave at top and bottom of the wide bobbin-weave band. These served the purpose of decoration and also to separate the warps into groups of three for the easy insertion of the bobbin. There are sixteen of these groups of warps in an inch, making 46 per inch of singles. They are single-ply cotton and untwisted, that is, lie parallel to each other, not as a ply yarn. There are 38 weft per inch of two-ply alpaca. The colors are red and yellow.

Referring to the diagram it will be observed that, reading from left to right, the red weft appears on the surface in the following order: over one, under three, over two, under one, over two, under one, over one, under three. The second line representing the yellow weft appears as follows: under one, over three, under two, over one, under two, over one, under one, over three. Carefully comparing the lines in the diagram, it will be apparent that the second is the exact reverse of the first. In other words, where one appears on the surface, the other shows for the same number of warps on the reverse. If the diagram is followed all the way through, it will be seen that this order is the same throughout; the lower pick is always just the reverse of the one above it. This accounts for the design being the same on both sides, and the colors, the exact opposite.

It will be observed in the diagram (Fig. 27) that weft never appears on the surface over a longer distance than three warps. This keeps well within the rule for good weaving, which in extreme cases allows weft to go over five warp ends without going under one. Greater distances would have a tendency to cause loose weaving. In a number of specimens examined, the writer has observed no exception to this rule.

B-9637 is a piece of tapestry containing three stripes of bobbin-weave figures, one represents two cats in yellow and red, a second represents the same figures in red and blue, and the third is the interesting stripe. Originally, this stripe contained the same figures as the other two. The color combination was a fine shade of heliotrope and some other color which is almost completely rotted away, leaving the bare warps which it should have covered, to form design. The vanished color may have been a dark purple or brown.

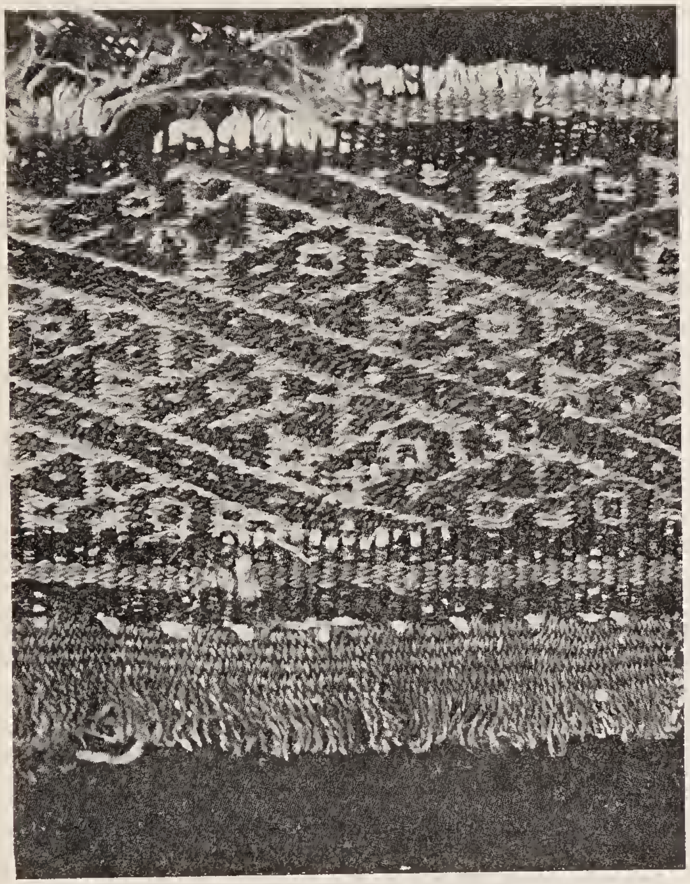

Fig. 26 (B–5917). Double-faced Bobbin-Weave Border.

The border of B-4319 is an example of single-faced bobbin-weave. The illustration (Fig. 35) plainly shows that the weaver paid no attention to the production of design on the reverse, the sole concern being to mass the colors on the surface in such an order as to create the desired pattern.

The figured stripe in B-1225 is the finest example of double-faced bobbin-weave in the entire collection. The design treatment is original, using a geometric conception in a most skilful fashion. The colors are clear and harmonious. The unfigured portion of this marvelous fragment is tapestry, containing 44 three-ply cotton warps to the inch and from 260–280 two-ply vicuña. Reference was made to it in the first paper. The lack of certainty in regard to weft count was caused by the great tenderness of the picks. They often broke when being withdrawn, and the allowance made was an endeavor on the writer's part to strike a proper average. It seemed

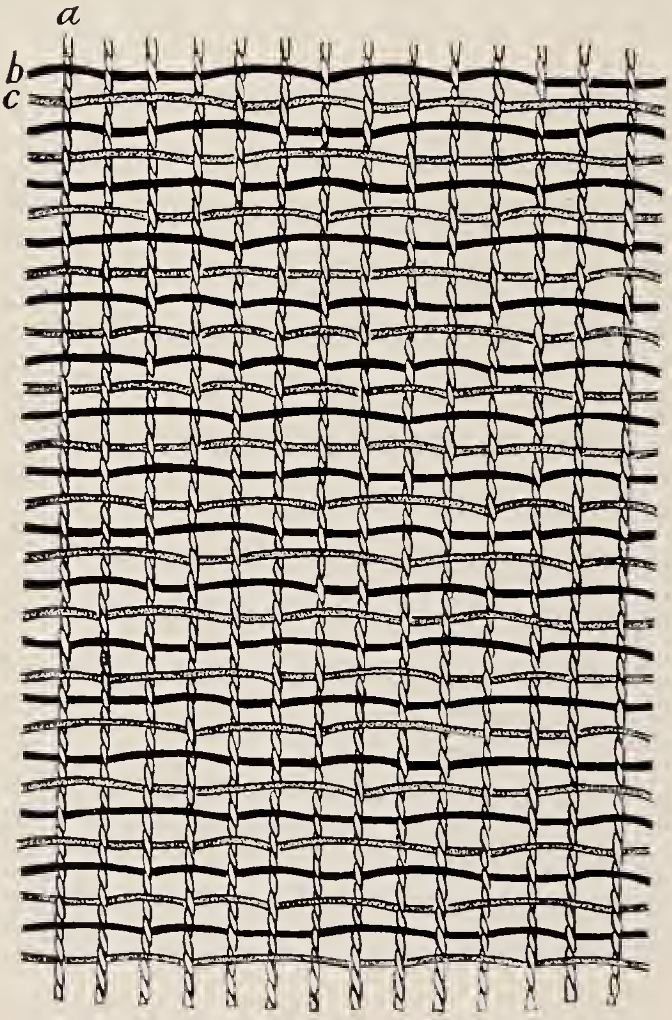

Fig. 27. Border of Bobbin-Weave. *a*, warps; *b*, red weft; *c*, yellow weft.

a useless desecration to destroy another inch of this masterpiece. The bobbin-weave stripe appears to be quite as fine, though perhaps the nature of weave causes it to approach nearer to the lower figures. Originally, the fabric was perhaps twenty-three inches wide, the stripe is about three inches in width, the take-up in this fabric is entirely in the weft and must be at least twenty percent. The stripe contains therefore 780 picks of weft, and each appearance over or under warp had to be considered in forming this design. Aside from the stripe, the entire fabric was about thirty inches long. Figuring 280 picks to the inch, in the plain portion this would give 8400 plus 780 in stripe which equals 9180 weft picks in the fabric, each pick was 23 inches long with at least twenty percent added for take-up. It therefore required 263,368 inches or 7315.77 yards of weft to weave this fabric. The allowance for take-up in the weft is entirely guesswork and was probably much greater than estimated. Considering the stripe alone, we find that design of a complicated nature was formed in a space three inches wide and twenty-three inches long, by the interlacing of 780 picks of weft with 44, the number of warps contained in an inch, multiplied by 23, the width of the fabric in inches, or 1012 warp ends. This, of course, is far too complicated to be ascribed to sheds formed by healds. The weaver simply darned this stripe and instead of assuming any ridiculous number of heald rods, we may safely attribute this stripe to the skill of the weaver in darning.

This remarkable organization is rather a tribute to the spinner as without perfect yarn of great evenness and smallness of diameter, the weaver would be unable to achieve such marvelous results. Mechanical skill is the natural result attained at some period in a craft universally practised in one locality for great periods of time. It is to the philosophical basis of this technique (if I may apply such a term) to which the reader's attention is directed. Here is a highly complex design built up one pick of weft at a time, requiring 780 picks to complete it. Each crossing of weft over or under warps, causing a minute spot of color on face or reverse, had to be considered in advance of each pick. It is perfectly woven, in no instance does weft go over or under warp more or less than the design required. How such weaving was possible without some form of draft or diagram to go by is most extraordinary. There is a great similarity in design in Peruvian webs, but no two are exact duplicates. Each, if woven today, would require an individual draft. No doubt the conventional geometric figures, which appear to be the common property of other advanced textile races and the realistic representations peculiar to Peru, were well-known to each weaver, but the mechanical structure of each fabric had to be thought out by the worker almost independently of every other. It is barely possible that the knotted strings known as quipu still used in the highlands of Peru to keep the tally of herds, may have been used as a guide to weaving, but no evidence of this exists, and in no instance, does the writer recall finding any examples of this ancient counting method in work baskets of the buried weavers.

In Wm. S. Murphy's "Textile Industries" the method of weaving cashmere shawls is described. The case is by no means analogous, but serves to show how some apparently complex methods admit of rather simple explanation. One man made the design in black and white; a second decided the color combination. This was read to the actual workman in a kind of craft argo — as each figure was traced in India ink on the bare warps, the weaver tied the proper amount and color of weft in its proper position on the warps.

The writer has observed skilled workmen repairing large holes in valuable rugs, containing complex design. No drafts were used, the weaver knotting in the pile knots in their proper relation on the new warps, apparently by instinct. But, if the instinct, so-called, were not backed up by years of practice, the result would be disastrous. The probable explanation of the enigma is that where textile art is so generally practised and carried to such a remarkable degree of complexity, the people may be said to think in textile terms. How strong the tendency is, becomes apparent when we see textile figures transferred to pottery and stone work.

In the period we are considering, each weaver of Peru, had at his command a great number of textile designs, the heritage of centuries of practical experience. He may have been able to combine them in whatever colors his taste decreed with the same lack of extraneous aid that an artist requires to combine his pigment into a picture.

If we endeavor to explain this manipulation by the extensive use of healds the following facts must be considered. All warps that required to be lifted at one time would have to be tied to a separate heald rod. So varied are these groups that the heald rods would cover so large a space on the warps as to make weaving very difficult, if not impossible. Reference was made above to the take-up incident to the crossing of warp and weft in weaving appearing only in the weft. The hard twist in the warp partially accounts for this, but the way in which weft was inserted perhaps plays as important a part. The bobbin was used like a needle and each pick was darned over or under warps, the plane of which was never disturbed. Take up is the extra length of yarn necessary in weaving calculations to account for the distance taken up by the interlacing of the warp and weft. This appears mostly in weft, the softer yarn naturally yielding more to pressure. For example, in our weaving, to get a fabric a thousand yards long, about twelve hundred yards of warp are necessary.

In the Peruvian web under consideration the warps are very hard and the weft comparatively loose in twist. There must have been great tension on the warps in the loom to allow for the degree of beating up necessary. The weft was picked in a slack condition. When a pick of weft is withdrawn, it shows the deep indentation of the warps, whereas warps are perfectly straight. Therefore the take-up was entirely in weft.

TIE DYEING.

Among the many fabrics from Peru which suggest so forcibly the textiles of Asia, none is so difficult to explain as a form of resist dye known as tie dyeing (Fig. 28). In resist dyeing fabric is so treated that when put in the dye pot, only certain portions of it absorb the colors. One form of this craft was to tie little bunches of cloth with a cord either soaked in clay or wax or spun from fiber which has no affinity for the colors and then dip the tied web into the pot. This tying was done in such a way as to produce design by the small circles or rough squares covered by the cord and therefore left undyed. By tying different knots while leaving the original in place and starting with the lightest shade for the first immersion, it is possible to produce designs of many colors.

The Punjab perfected many different forms of this technique. The most remarkable was one in which both warps and weft were tied at carefully arranged intervals and woven so the corresponding spots came together in the fabric. Another was to tie small portions of the warp with strips of bark before weaving and then dye it; a third, was the one mentioned above in which the woven fabric was treated. This last mentioned technique gave its name to the bandanna kandkerchief.

It is curious to note how persistent certain of these methods are. The Moslem conquests spread tie dyeing of fabrics into the Philippines, the Bagobo tribes being especially skilful in its use. No doubt webs of this character have been found among a Nigerian tribe, who learned the craft from the Arab traders. How ancient the craft is, can only be estimated. In the Metropolitan Museum of Art is a small fragment of Saracenic silk in which the warps had been subjected to this process. This fragment is attributed to the seventh century. In the Museum of Decorative Art is a second much larger specimen dating from the tenth century. The change of color in the continuous thread was at first very confusing to the writer. Later, however, a study of Sir George Watt's "Art of Delhi" cleared the matter up. We can also safely say that the Moors carried the craft into Spain, and the Spaniards in turn carried it to Mexico along with the silkworm. Today the weavers of Guatemala apply this craft of ancient India to silk and cotton fabrics.

In dwelling so long on subjects not directly pertinent to this paper, the writer's purpose was to show two facts. First, that this method readily appeals to every people even slightly familiar with textiles, and second, wherever it appears, except in one place, its Asiatic origin can be clearly traced. This exception is Peru.

There are certain features of originality about this technique which make it difficult to see how it could have developed gradually. The whole process is required to produce design, and the several operations apparently owe their invention to a single mind. The evolution, so clearly suggested in other processes of weaving, is here absent or extremely vague.

The craft in Peru, as far as we know, never extended beyond the simplest form. This nevertheless, was carried to a certain degree of perfection. It seems difficult to say that such an unusual method was the result of an intellectual accident in Peru and Asia, while in every other place where it appears, there is historical proof of its origin. Like gauze, this technique is very suggestive.

Fig. 29 is an interesting example of one form of resist dyeing. A light loosely woven cotton fabric has been decorated with alternating stripes of white and brown. It was first doubled on the bias and then rolled up in a long cylinder. There is nothing to show exactly how the brown stripes were formed, but the probable method was that in the space covered by the white stripes some fabric was tightly wrapped and then the whole thing was dipped in a dye pot. The stripes correspond through the entire thickness, and this would be impossible if the stripes had first been painted and then the web rolled up. The effect of folding on the bias is that the stripes run diagonally to the warps. This process, to the best of the writer's knowledge, is peculiar to Peru.

No examples of fabrics actually tied for dyeing are in the collection. A later form practised in India today and applied directly to modern printing, was to cover the surface to remain undyed with wax. After dyeing, the wax is extracted. In this work, however, the figures are clearer and more regular than where the irregularity of the strings allowed the colors to penetrate more freely to the edges of the undyed surface. The use of string is certainly the more ancient method and coupled with the peculiarity of Peruvian work, may be more certainly accepted as the method employed.

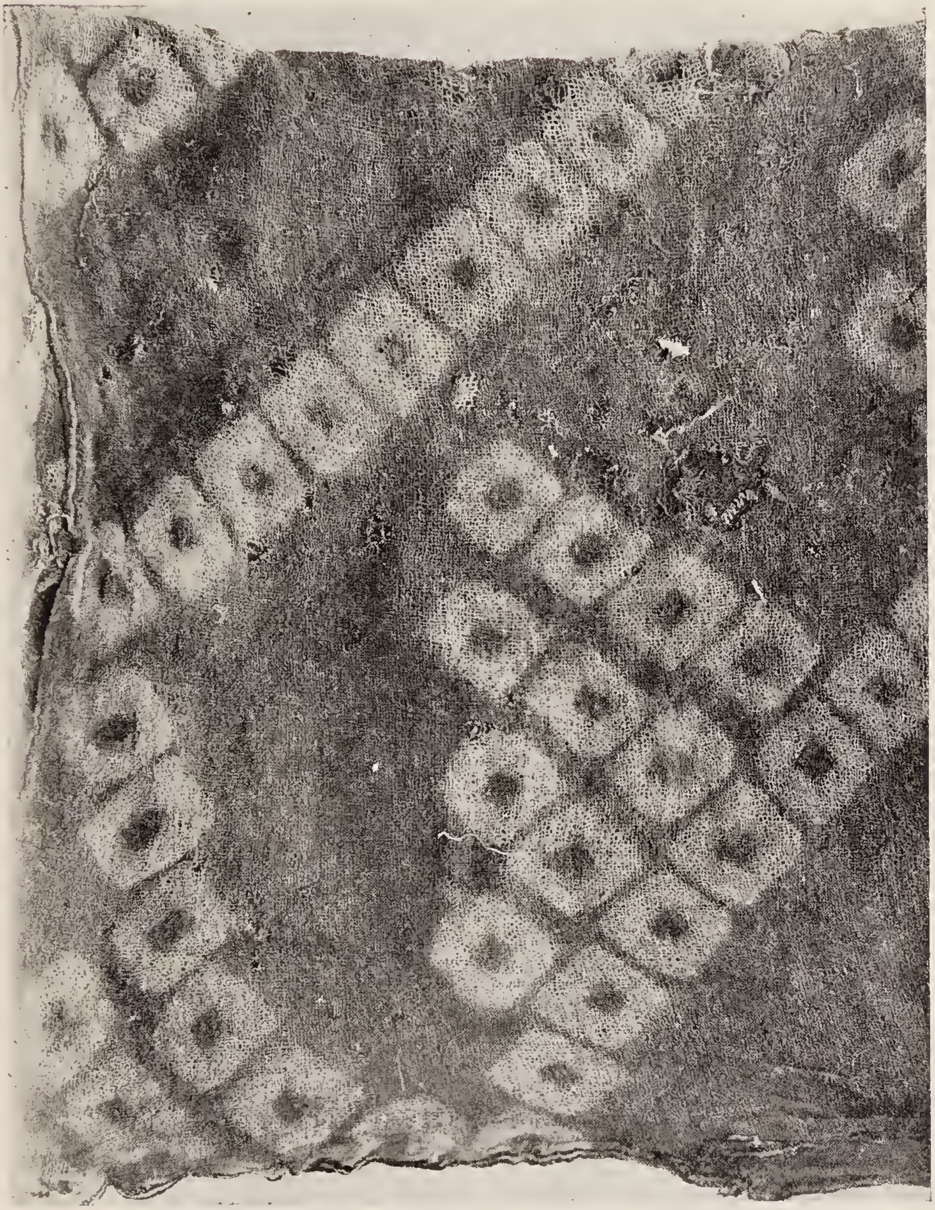

Fig. 28 (B–1264). Tie Dyeing or Bandanna.

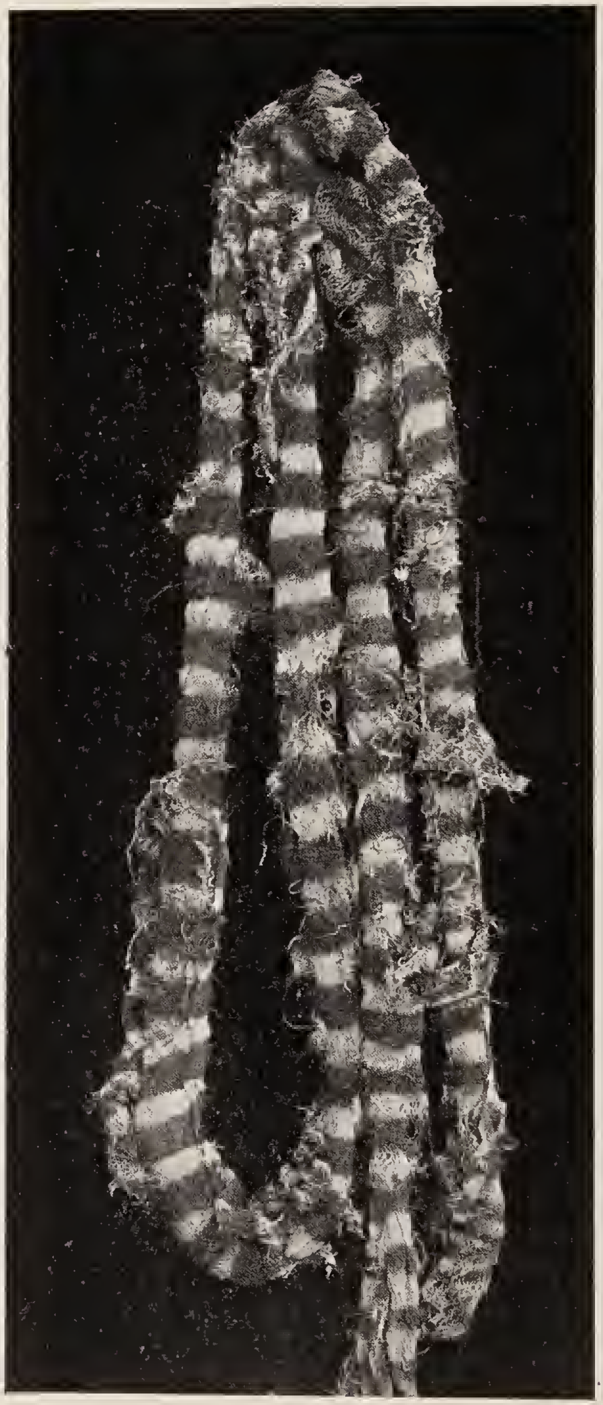

Fig. 29. Methods of Tie Dyeing in which the Cloth is rolled into a Cylinder, then Tied and Dyed.

PILE KNOT.

The commonest forms of pile knot in Peru are found in the ornamental ropes, the use of which is not quite clear (Fig. 32). A few fragments of narrow belts or bands which show a rather more extensive knowledge of this interesting technique than the number of examples would indicate, have lately come to light. These fragments contain designs formed by attaching knots of colored fibers to a basic fabric. Two slightly different methods were employed, and in one example, two colors and in the other five, have been employed to produce design. While their surface appearance is the same as Oriental rugs, they are quite distinct from a technical standpoint. The carpets of Asia are decorated by knots of dyed yarns so loosely spun as to readily separate into fiber after being attached to the basic fabric, but this does not obviate the fact that they were originally yarns. A careful examination of a number of knots from the Peruvian webs, proves them to be merely untwisted bunches of fiber. But the great difference between the two techniques lies in the manner in which these yarns or bunches of fiber were incorporated in their respective fabrics. Roughly speaking, the Oriental method consisted in knotting short pieces of colored yarn to the warps of the fabric and binding them in place by the insertion of weft. The basis is in reality a plain woven fabric, containing the two essential elements of warp and weft. In other words, every rug contains three elements: warp, weft, and pile knot. Peruvian webs of this character contain only two elements, bunches of fiber of a decorative character, and a single thread which is looped upon itself in such a manner as to form a very open knitted web. The knots are caught in portions of this fabric as they are being formed. The diagram will show this much more clearly than can the written text (Fig. 30). *a* represents the cord looped on itself to form the basic fabric; *b*, represents the knots of wool and hair. It will show that in a technical sense no two fabrics could be more unlike. Rugs are plainly a development of woven textiles, they belong to a class closely related to tapestry. In fact, the earliest rugs were unpiled kelims or actual tapestry. The Peruvian fabrics, (Fig. 31) on the other hand, belong rather to the division of fabrics of which lace is the highest form, and are a development of nets. After these knots were attached they were cut so as to give an even surface. This cutting is very even, but we have no knowledge as to the implement used.

Compared with tapestry, pile knot is a thing of yesterday. There is strong evidence to support the theory that the modern form of rug came into existence rather late in the textile development of Asia. The use of fabrics for a floor covering and as hangings no doubt had a tendency to suggest some form of textiles resembling fur, and while no shred of evidence remains to prove the theory, perhaps some intermediate form arose in which a partial use of pile such as tassels gradually evolved into the modern carpet. Tassels were very often used in decoration in Peru. A highly ornamental loin cloth formed from a net covered with red tassels is in the Museum collection. This may be the prototype of the pile bands described above. In Peru there were no fabrics except the sleeping mats which were unquestionably floor coverings. It is not too much to assume that had such a want arisen, these skilful weavers would not have been long in carrying the technique still further and at last attaching the knots to the warps of their tapestries.

No definite use has been assigned to the pile knot cords of Peru (Fig. 32). That their function was largely ornamental there can be no doubt. Perhaps they were ceremonial llama harness. From their great length it seems doubtful that they could have been used as belts. They vary in thickness from a scant quarter of an inch to perhaps three quarters, and in color from solid red and dark yellow to red and black and are composed of narrow alternating stripes of yellow and brown.

They are composed of three elements (Fig. 33). The core contains three two-ply cotton yarns twisted together. The pile knot or loop is composed of a mixture of wool and hair, and the small hard twisted yarn which binds the fiber to the core.

So far as can be determined, both these piled fabrics are peculiar to Peru. They occur no where else in the world. They indicate better to what an extent the ingenuity of these people had developed along textile lines, than could a volume of mere assertion. From the fact that the belt-like pieces, although few in number and selected in a haphazard manner, still show two distinct methods of attaching the knots, and from the evident ease with which the technique was employed in the production of design, it would seem but reasonable to hope that further excavations may uncover much more extensive collections.

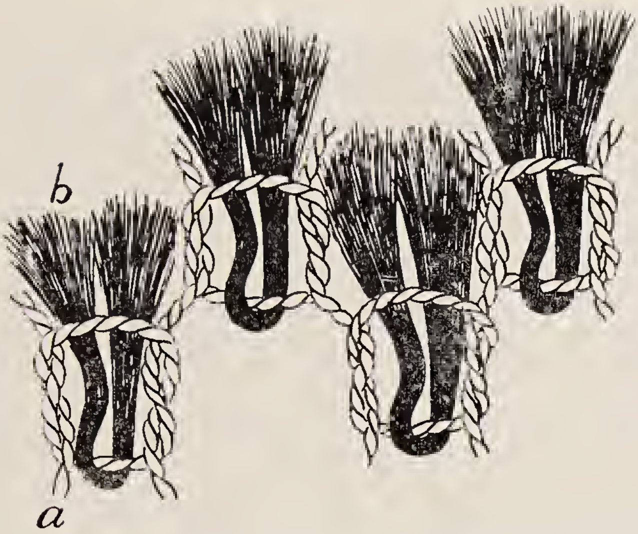

Fig. 30. Pile Knot. *a*, the basic fabric, a single yarn knotted on itself; *b*. the pile knot caught in the knots of *a*. In the fabric the loops are much smaller in relation to the knots, than in the illustration. The knots are hair and wool and the cord is a two-ply closely twisted cotton.

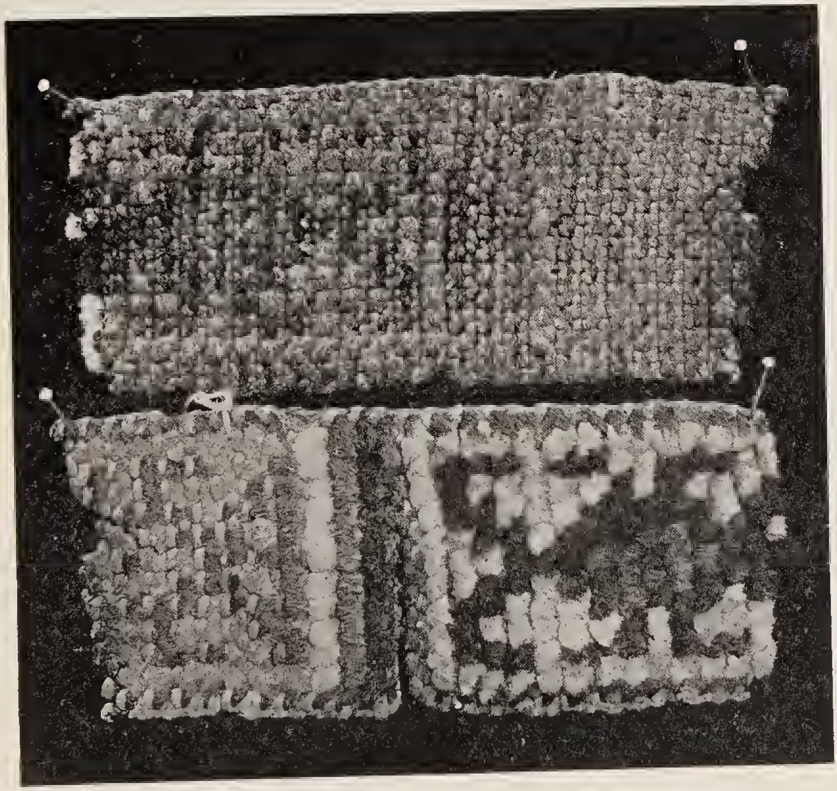

Fig. 31 (B–4751). Pile Knot Ribbon containing part of a conventionalized Human Figure.

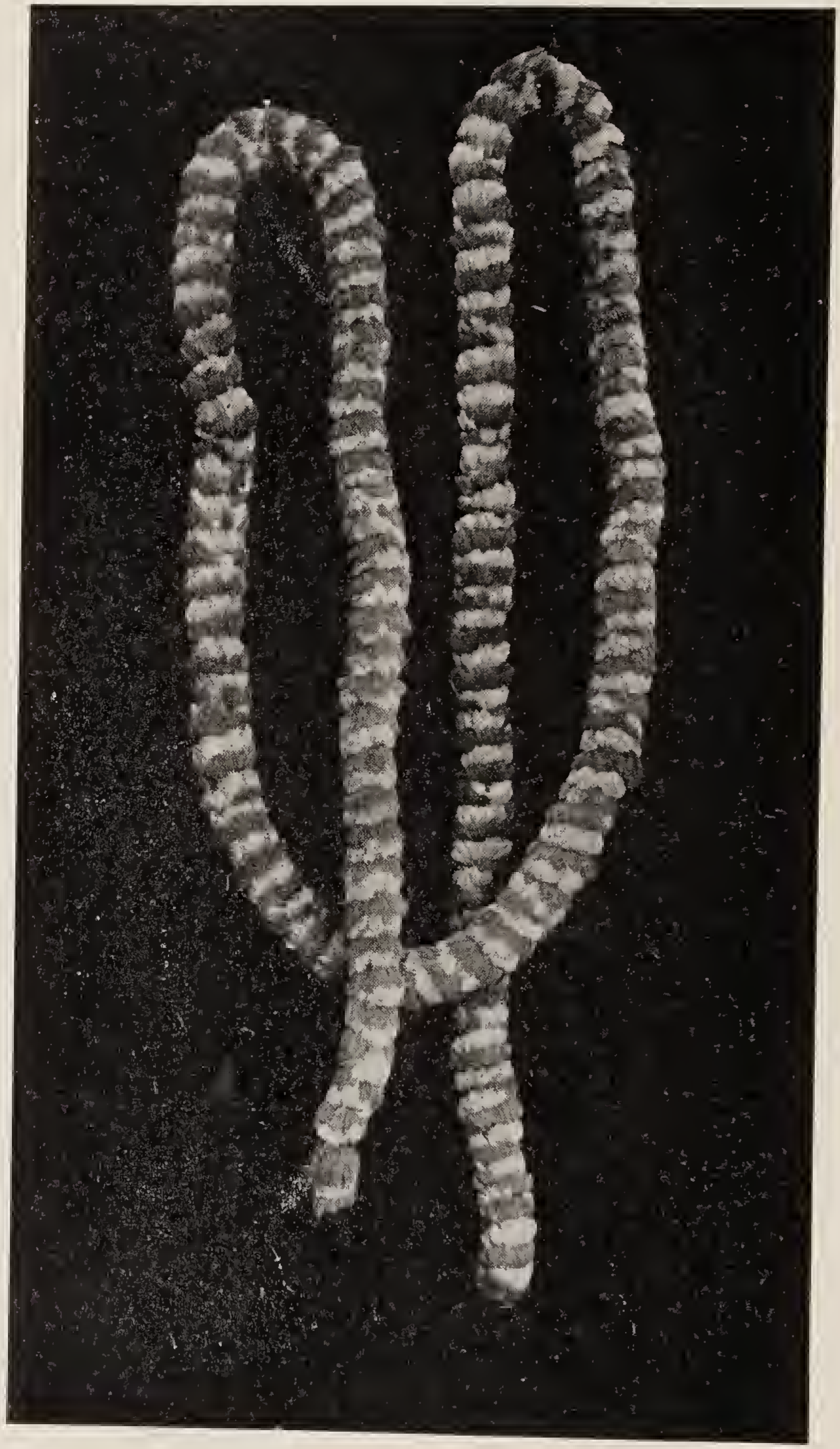

Fig. 32 (B–582). Pile Knot Cord.

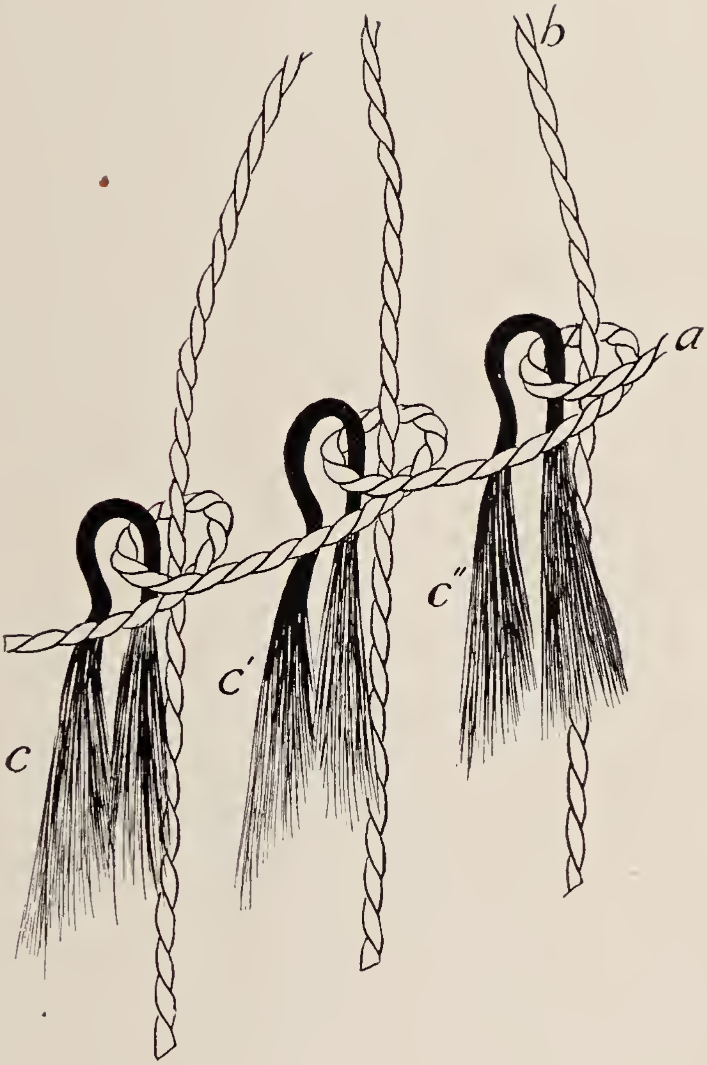

Fig. 33. Two-color Pile Knot Rope: *a*, binding cord; *b*, the three cords, which twisted around each other, form the core; *c*, *c*,′ *c*,″ the knots caught in *a* and wrapped around *b*.

MISCELLANEOUS TECHNIQUES.

Certain Peruvian textiles do not readily lend themselves to modern classification and yet are so interesting as to deserve description. B-8695 is a maguey fiber lace bag. The designs have been skilfully knitted in the webs and then emphasized by painting the plain portion of the bag. They have not been dyed, but actually covered with a paste-like substance containing the coloring matter. The yarns in these bags are two-ply maguey, very finely spun and containing an amazing degree of twist. This twist gives them a very wiry feeling.

There is a poncho in the collection resembling a rough Turkish towel. A somewhat similar method of decoration was used by the Coptic weavers and occasionally they carried the craft still further and inserted colored yarns in the looped wefts. Between every ninth warp the weft has been pulled out so as to form a loop. These weft loops hang down in a fringe separated from each other by a space in which the weft had been inserted in the ordinary way for ten picks. The loops are longer than the width of these plain strips and cover the entire surface of the poncho.

The old weavers of Peru had a great aversion to leaving the edges of their garments undecorated. Generally, the last two or three inches were covered with a border of different design and color and often woven by a distinct technique. Besides these borders, fringes were often attached. Sometimes these were neatly sewed so that the thread only appeared on the back but more often they were incorporated in the fabric of which they formed a decorative element. In hand loom webs, the warp and weft are continuous threads. At the selvage and at the loom string they are turned back into the fabric and leave loops, to which the fringes can easily be attached. Fringes were sometimes made by twisting pairs of unpicked warps together. These turns are very close and apparently are held in place by the force of the original twist. Perhaps the twist was secured in some other way at first and permitted to set before released. B-1284 is a sleeping mat. The fiber is cotton and the soft mat-like surface is obtained by the use of slubbed weft yarns. The warps are two-ply cotton hard twist so as to firmly lock the weft and to bury itself in softer twisted yarn. The weft is also two-ply between the slubs sufficient twist being inserted to make the yarn strong enough for weaving.

The plain cotton ducks of Peru vary from rather fine construction as specimen B-8742 containing 142 warps and 44 weft per inch to ones containing 40 warp to 12 weft and even coarser weaves. Generally, the yarn is two-ply cotton and of very excellent spinning. It is curious to observe that the number of warps is greatly in excess of weft. This is the cheapest way to weave modern fabrics since the warps are all drawn in the loom at one time and the added labor cost of a reasonably fine warp over a very coarse one is very slight and does not interfere with the speed of the loom, whereas any appreciable increase in the number of weft pick material decreases the loom production and therefore raises the labor cost out of proportion to the increased fineness. It is interesting to note that this practice was well understood in Peru. It appears even in ornamented webs such as warp stripes. It must have required a very nice adjustment in the drawing in of such numbers of warps on these simple looms so as to equally distribute tension, and also afforded an ideal use of heald rods in making the sheds. The beating up of weft must have been a rather difficult process without the aid of some modern reed in fabrics containing large numbers of warps and this may account for the comparatively light picking.

B-8685 is a portion of an ornamented loin cloth. The decoration is a kind of embroidery resembling a chain stitch (Fig. 16). The yarns have been sewed through the basic fabric and then knitted together on the surface. Knitting was quite common in Peru, such examples as the woolen caps and bags being the ones met with most often. The combination of this technique with true weaving was a very natural development. There is a rare form of Oriental rug in which the same method of ornamentation is employed. The basis of the web is a loosely woven cotton duck and the embroidery covers this completely. There is apparently some confusion in names for this class of work, sometimes it is referred to as a Cordova or Moorish and again as Cashmere. However, a confusion in the names of Oriental rugs, based on the supposed place of origin or barter is by no means uncommon, and anyone familiar with the class of carpet referred to will have no difficulty in seeing the relationship here evident.

Lace is generally assumed to be a later textile refinement, but its origin in useful fish nets makes it certain that many techniques were as old or even older than true woven design. In the collection are many fine bags made from two-ply yucca fiber yarns. The illustration is of a broad ribbon of lace. It is cotton and shows the conventional interlocked bird heads as its principal design (Fig. 34).

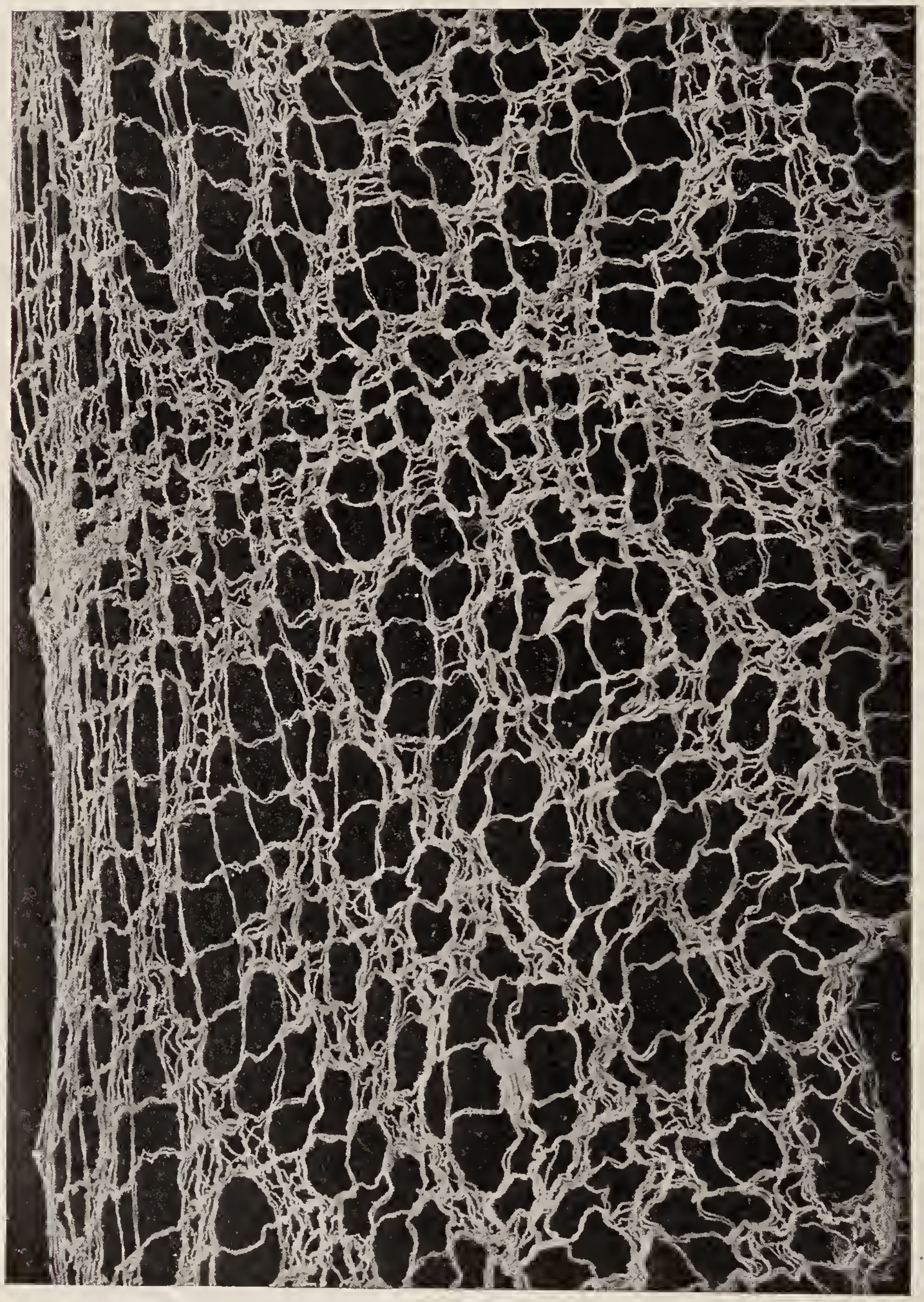

Fig. 34. Lace.

MECHANICAL DESIGN.

The term mechanical design has been chosen to designate a class of ornamentation produced solely by the mechanical operation of weaving. The patterns are absolutely devoid of either realistic or symbolical meaning. For this reason, since double cloth, gauze, etc., are occasionally the vehicles for conventionalization, they are excluded from this chapter. Warp and weft stripes, and their combination in plaid or ginghams, fancy warp stripes, and certain fabrics decorated by warp manipulation will be chiefly considered. However, examples of pure geometric figures in tapestry and a mechanical explanation of their origin are discussed.

When weavers began to use dyed yarns, either for embroidery or tapestry, it soon occurred to them to pick a bobbin of colored weft right across the warp. This produced a stripe of color in the weft. This stripe would be a solid color except where the undyed warps appeared on the surface at the intersection of the warp and weft in weaving. This refers to fabrics which are not tapestry. Its width depended upon the amount and size of the weft used. This must have been a very early method of design and is used today by peoples having only slight textile knowledge.

Soon, however, the idea of making stripes run the length of the web took form. This was accomplished by drawing in the loom, larger or smaller groups of warps of color different from the rest of the piece. Here the width of the stripe varied with the number and size of the warp ends it contained. This was rather a mechanical advance since it required more forethought to arrange a parti-colored warp than merely to insert a bobbin of dyed weft until a stripe of the desired width was complete or until the bobbin was empty. Many very fine shawls are ornamented with plain warp stripes differing in width and in tone, forming a most pleasing combination. The fabric (B-5449) contains 104 warps and 34 weft per inch. The yarn is two-ply cotton, the warps handsomely dyed. The great predominance of warp and the careful crêpe twist in the yarns causes this set of threads to appear only on the surface. The fabric is ribbed like tapestry but the repp is produced by weft and not warp as in the former example. In this fabric there is no deviation from a plain weave, but in B-1379 we have a fancy stripe produced by the order in which certain warps are left unpicked. This may be said to be the exact reverse of bobbin-weave where design is produced by the weft going over or under varying groups of warp, since these warps go over varying groups of weft in the production of design. Similar figures are produced today by means of extra heddles on simple harness looms. They are caused by warp appearing on the surface for a few extra picks of weft.

No doubt, weft striping and warp striping were both well advanced before the two methods were combined in a single web to form simple check or gingham patterns. There can be little doubt, however, that this method is very ancient, for it has been carried to a remarkable development and a great variety of patterns appears in the specimens on exhibition in the Museum. These pieces bear an interesting likeness to modern fabrics. This is not so remarkable when we consider that combinations of colored warps and wefts have been made for centuries in both parts of the world and the ultimate results achieved would very likely be similar. It is interesting to note that most modern gingham patterns are but copies of ancient Scottish Tartans.

It will be seen at once that careful arrangement of warp so as to have the colors in their proper positions was the first necessity of this class of weave. Next, bobbins containing the different colors of weft were prepared and inserted in the order necessary to produce the pattern. The whole operation required a careful consideration and calculation. Where warp and weft of the same color interlaced, areas of solid color would be produced, but where yarns of different shade combined, there would be a stripe or square of a shade composed of the two. The characteristic slack weft of tapestry and bobbin-weave which allowed the weaver to completely cover his warps was absent in these fabrics. Both filetal units appeared in the web and therefore the designer had to make allowance for each. The many complicated patterns are sufficient evidence that this class of textiles was well represented in ancient Peru. However, it is but fair to say that in this technique at least, the product of modern mills is superior.

Fig. 35 represents a rather unique weave. It is an ordinary gingham shawl composed of two fabrics which have been sewed together, and has a border of single-faced bobbin-weave, rather coarse in texture. The designs in both fabrics are the same, but curiously enough, the units seldom correspond in size. Evidently, no exact draft was used in weaving or the fabrics would more nearly correspond. The pattern is a series of rectangles more or less even. In each rectangle is a second square or oblong of white. This is produced by combining the white warp and weft in this portion of the web. The white warp is crossed by no other weft and the white weft picks or other warp in these figures. This is what is called floating a figure on the surface of a fabric (Fig. 36). It is an application, in a small way, of double cloth weaving and probably explains the origin of this latter class of fabric.

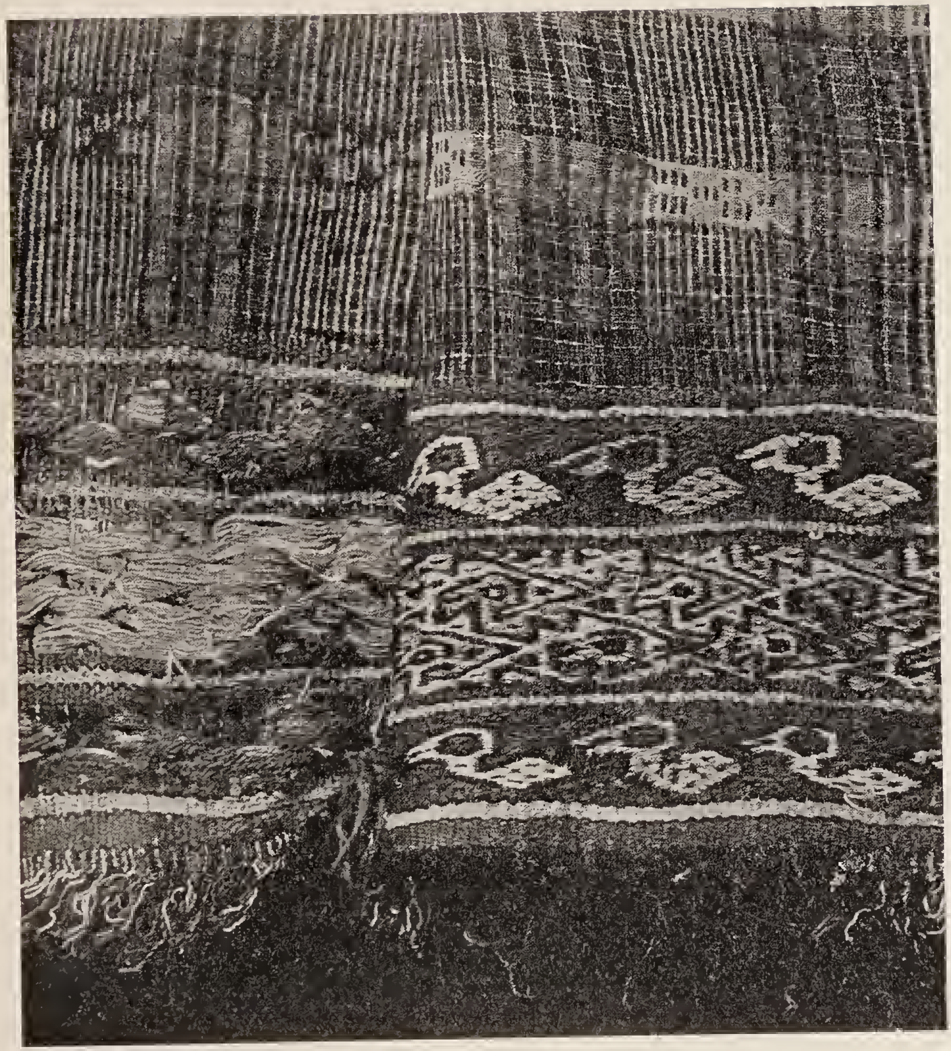

Fig. 35 (B-4319). Gingham with floated White Lozenge Figures having a single-faced Bobbin-Weave Border.

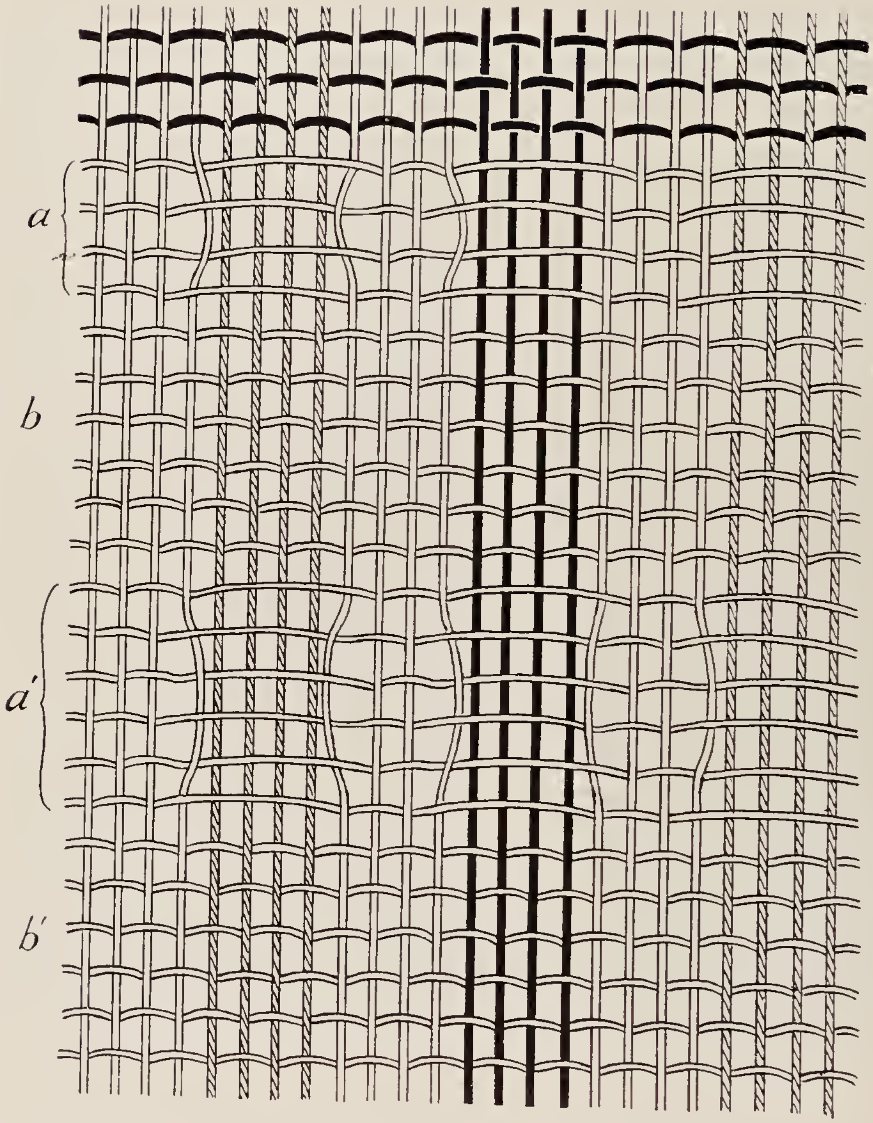

Fig. 36. Diagram of Cloth shown in Fig. 35. *a, a,′* portion of the web in which the white warps are picked only with the white weft, forming the white surface; *b, b′* portion of the web in which the interlacing of warp and weft of the different colors is in regular succession.

Referring to the mention of the origin of double cloth, it can easily be seen that most styles of weave have been suggested by simpler forms. A weaver becomes extremely skilful in a certain technique. In attempting to relieve the monotony of the product, certain slight modifications are indulged in. The accretion of these weaving tricks ultimately becomes so great that they create a new type of fabric perhaps very different from the original web. In the example under discussion, it appears that a novel effect was produced by combining the white yarns for a short space. Carried a trifle further, assume the two browns also to have been combined, etc. The weavers must have been dull indeed not to comprehend eventually that by so combining different sets of warp and weft in the above manner, a distinct type of fabric would be the result.

Fig. 37 is a photograph of a narrow belt. It contains a simple but pleasing geometric design of gray and black. The pattern is produced by the appearance and disappearance of these colored warps on the surface of the belt. Both sides contain the same designs but the color proportions are reversed. The texture is very solid and the fabric is still remarkable for strength. This technique must have been very desirable to primitive weavers. It occurs over almost the entire cotton area. Fine examples of it are woven in modern Colombia, among the wild tribes of Nicaragua, among the Navajo and Hopi, and in many other districts. In some respects it resembles double cloth which is also very widely distributed. I doubt if this is indicative so much of early origin as of a convenient and simple method of decoration.

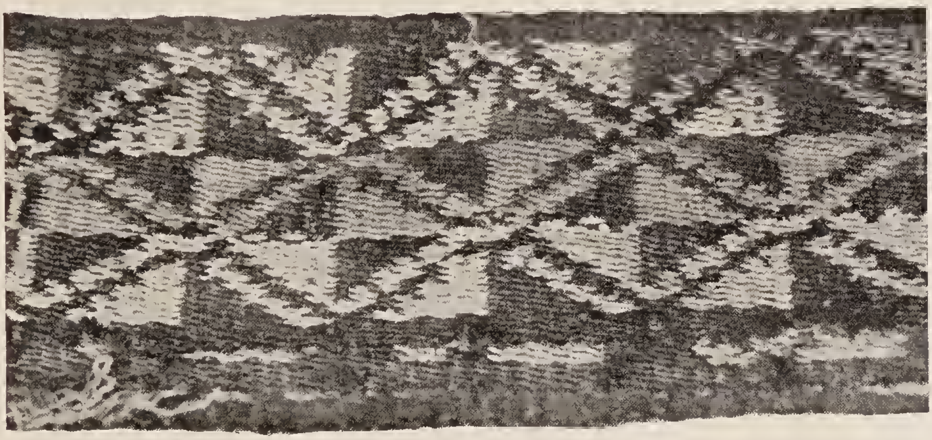

Fig. 37 (B-4642). Narrow Belt in which Geometric Design is produced by contrasting Warp Colors appearing on the Surface or Reverse.

Examples of tubular weave occur in Peru. The warps produce design. Such ends as are not required in any portion of the fabric serve as a core and are picked up and exposed on the surface wherever design requires. The colors are exactly reversed on opposite sides and at intervals the entire color scheme changes from one side to the other. The end of the tubular weave is composed of a knitted fabric in which all the warps used in the web are combined without the aid of weft. No exact duplicate of this technique exists today and only the most general idea of the processes of manufacture can be conceived. It is but another example of patience and skill.

The above examples by no means exhaust the techniques which might properly be considered under this heading. Sufficient, however, have been given to show the wonderful versatility of this people in the mechanical problems incidental to weaving.

The ginghams are almost always of cotton and the condition of the dyes is very remarkable. This fiber is, excepting linen, the most difficult to dye in fast colors. Perhaps the best results were obtained by dyeing in the fiber instead of the yarn. A small ribbon of dark blue cotton fiber was found in a gourd and perhaps represents one of the processes. However, dyed cotton warps are illustrated in the chapter dealing with the drawing in of warps in the loom and some fabrics have been dyed in the piece in dark blue and one in a light shade of lavender, and even these have kept their color after all the centuries. It must further be borne in mind that there is no evidence that these fabrics underwent any finishing process after leaving the loom, with the trifling exception of piece dyeing mentioned. Our modern webs are vastly improved in set and appearance by the subsequent finishing processes.

All kinds of textile design in which the units are balanced or in which the same figures are repeated, require some form of prearranged plan. Even in plain weaves, the fact that each square inch of fabric contains almost exactly the same number of warps and weft, necessitates calculation which commences with the spacing of warp in the loom and ends only with the final beating up process. In tapestry it was necessary to estimate how many warps each figure would cover, and how many picks of weft would be required to weave it. In embroidery a similar calculation was applied to each figure with reference to space it should occupy on the web. This space was estimated in terms of warp and weft, but the calculations in both these styles were so simple, as to require for their successful application little more aid than that offered by the nice sense of proportion incidental to fine craftsmanship.

Quite a different condition arises when such complicated methods as double cloth, bobbin-weaving, brocade, and gingham are considered. These techniques required most careful and complicated prearranged plans. That these plans took a form in any way resembling modern mill designs is doubtful, certainly there exists no proof of any such designs. However, some form of plan or notation must have existed unless we are to assume a degree of memory sufficiently great to carry in mind the exact relationship of hundreds of threads crossing each other at right angles. Examples of great feats of memory among primitive peoples are not wanting, and the skill of Oriental hand loom weavers in producing webs of cloth with little aid from diagrams, such as are indispensable to modern weaving, is too well known to require comment. When a certain figure or group of figures repeat in design, the most difficult calculation is of course the first; the balance being merely repetition. When once such a pattern had been worked out, the details might easily be committed to memory. However, this could hardly apply unless the subsequent fabrics were exact duplicates of the original. Any deviation in count or proportion would require a separate filetal arrangement. In Peru there are strong resemblances between many fabrics but exact duplicates never occur. Therefore, each web requires a separate calculation, at least sufficient to comprehend this slight difference in texture or design.

In bobbin-weave the appearance and disappearance of two alternating colors of weft had to be carefully arranged for. In double cloth the raising or lowering of two warp and weft elements was planned in advance. In ginghams, the interlacing of warp and weft was the same as in plain weaving, yet a careful calculation as to just where the different colors of warp and weft should cross contrasting shades or where combined with the same color, was necessary to the production of well-balanced patterns.

In other words, the exact spot where these different things were to take place had to be arranged before the operation of weaving began. In bobbin-weave the order of picking alone required consideration; in double cloth, both warp and weft required attention; and in gingham, a further planning was necessary since here the process commenced by a careful arrangement of the different colors in drawing in the warps. The space each figure was to occupy on the warp surface was therefore calculated before the bobbin was nserted in the warps. Now space in weaving is estimated not only in inches but more particularly by the number of warps one way and the number of wefts the other. This required a degree of mathematical calculation by no means contemptible. It must be further borne in mind that every square inch of each fabric, except in the cases where the technique varied, contains almost exactly the same number of warp and weft. To accomplish this, every operation of weaving from drawing in the warps and spacing them in the loom, to beating up, had to be planned.

It is perhaps unwise to predicate undue conscious mathematical calculations in explanation of these facts. The subconscious dexterity of skilful handcraftsmen is sometimes as exact in result as are the efforts of the scientific prearrangement. Besides this, some fabrics have at one or both edges, a small border composed of portions of the figure of the design. This may indicate that there was some mistake in the plan, although the desire to form a straight edge is perhaps as valid an explanation. However, this much is certain: the fabrics required careful counting of warp and weft to make them coherent in design. These calculations must have been in advance of the actual weaving, for certainly the results could not be produced by haphazard work. In order to accomplish this, a certain comprehension of abstract mathematics was requisite. In bobbin-weave or brocade this calculation included the use of both odd and even numbers.

TECHNICAL ORIGIN OF DESIGN.

The significance of similarity of design in different portions of the world is a problem for the professional anthropologist rather than the textile expert. The motives of art, environment, cultural relationship, and religion, are no doubt portrayed in the maze of figures. Somewhere lies the key to many mysteries of origin of apparently widely separated civilizations. The problem invites with all the seduction of mystery ever on the verge of solution, but the amount of ethnological and archaeological information requisite to these questions is rarely accessible to technical men and certainly is not possessed by the writer.

However, a certain amount of elimination can be accomplished by indicating a series of figures that appear to be practically universal in all weaving centers whether of basketry or true textiles. From the pottery decoration of the Swiss villages, copied beyond question from baskets, through Asia, the Pacific Islands, our Southwest, Mexico, and Peru, these figures occur. Even today many woven designs contain portions of them. It is generally admitted that the technique of weaving is the true explanation of this similarity, but I have never seen this explained in a technically thorough manner. Before passing to the diagrams which progressively show this, a word of caution may not be amiss. While the general form of the figures to be discussed may be accounted for on practical rather than aesthetic grounds, the same does not hold true of incidental detail. Where there is a similarity of detail that does not lend itself fully to further mechanical explanation, other fields of research are quite pertinent.

One of the earliest, if not the first, forms of woven design is tapestry.

In the chapter dealing with this subject, the openings in the web between contrasting colors on parallel warps have been discussed. Where colors come in contrast obliquely across the warp, these openings disappear, or rather are merely the width of the diameter of a single weft pick. This is so slight as to elude the unaided eye. Sometimes when exposed to a strong light the opening shows as a transparency. The significance of this is that

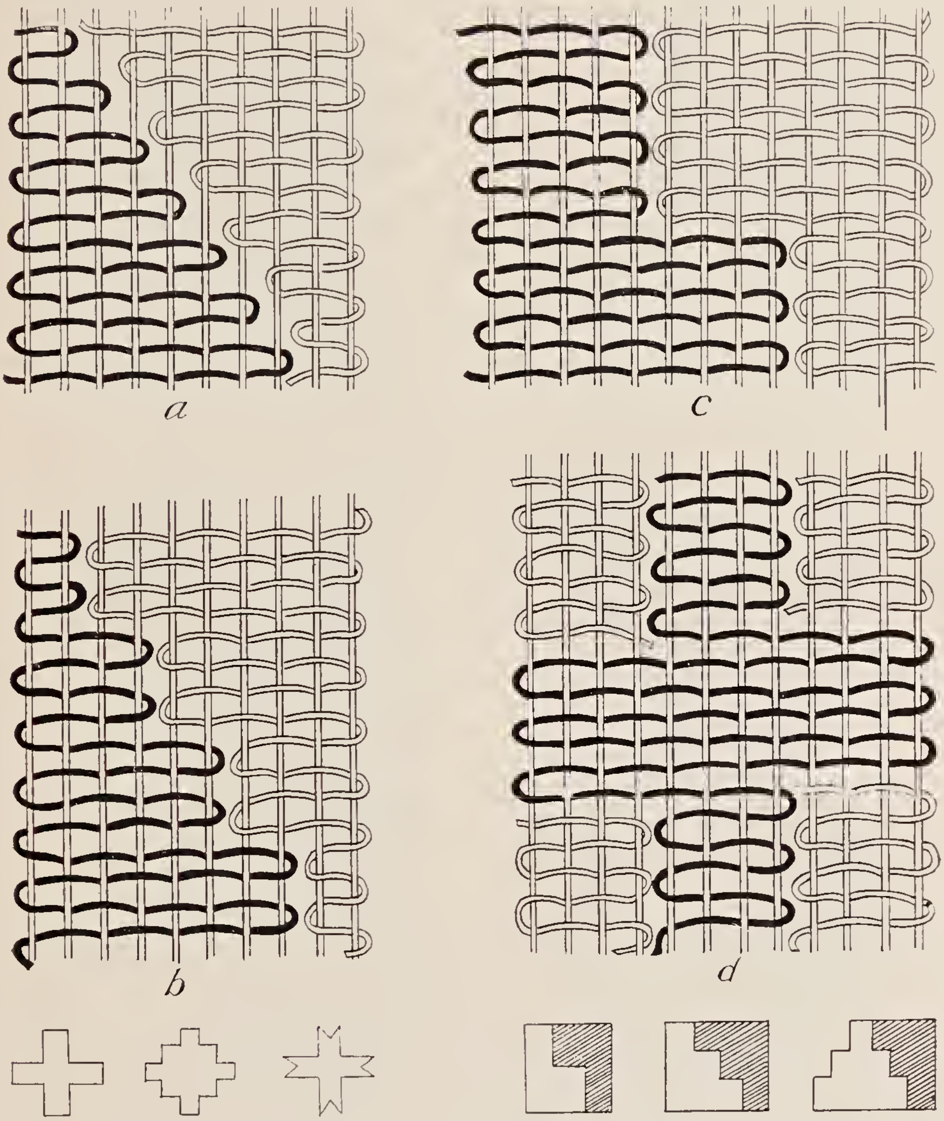

Fig. 38. Method in which certain Geometric Figures originated in the Technique of Weaving; *a*, a line in weaving where two colors come in contrast obliquely across the warps; *b*, slight accentuation of the step-like figure shown in *a*; *c*, the step-like figure carried still further; *d*, the method carried into a simple cuneiform. The small figures at the bottom suggest the different figures which have arisen from this technique.

the so-called oblique line of color demarkation is in reality a series of minute step-like lines like the teeth of a fine saw, each tooth being distant the breadth of one warp end from the preceding. This angular deviation from a straight line, while imperceptible to the eye, could not fail to have been evident to the weaver, familiar as he must necessarily have been with the technique. (Fig. 38.)

By a well-known rule of primitive psychology, what a savage cannot avoid either in nature or art, he is likely to accentuate. Hairless peoples generally extract the few hairs that appear with tweezers, while hairy tribes take great pride in flowing beards. Therefore, weavers very soon began to increase this saw or step-like line by increasing the number of weft picks contained in each section of warp. The effect thus produced must have been very pleasing. The very angularity has a charm of its own, since straight lines and exact proportion are things which in nature a savage seldom sees. It is by no means unusual to see entire webs decorated with a series of rectangles, grouped in cross-like figures. The possible combinations of this simple motive are infinite and variation in outline or proportion produces individual traits. Sometimes the accidental likeness to some realistic form caused slight addition in detail which carried the design into the realms of symbolism. Again, in attempting the delineation of realism in woven webs, the application of the technique produced at times an angular suggestion which on being accentuated finally developed into a pure geometric figure.

DRAWING IN WARPS.

The Peruvian loom is in theory very simple. In the first paper the more obvious technical features were discussed at some length. The importance of equal tension on the warps, the function of the loom string in lessening the strain of weaving, the use of the tie-string in dividing the warps in equal groups, etc., were all more or less carefully considered. Mention was made of several skeins of warp yarn, apparently formed into what is known as a warp chain (Fig. 39), preparatory to adjustment in the loom strings or bars.

The probable method of this adjustment will now be considered (Fig. 40). It is one of the accustomed disappointments in archaeological research that certain links in the chain of evidence should be missing. We can only do what the palaeontologists do in supplying a missing bone: reconstruct from suggestion and probability, the missing part. In other words, make an explanation consistent with known facts and pertinent to the function to

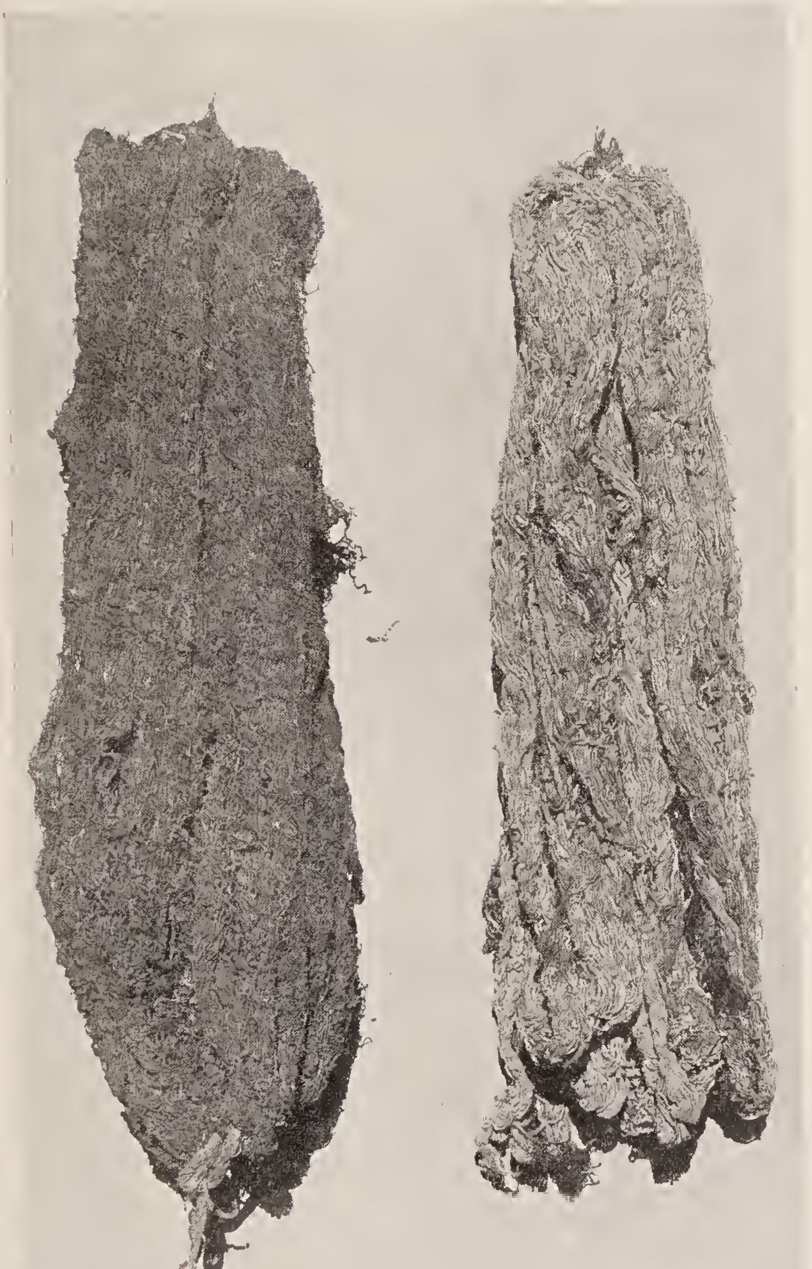

Fig. 39 (B-3781, 3782). Warp Chains.

be performed. We must bear in mind that simple as the processes of primitive textiles may be, they are nevertheless the result of the careful selection and elimination of mechanical evolution as truly as our more complex modern processes. We must look for and reject anything short of a continuous sequence of movement which neither more or less than explains the whole.

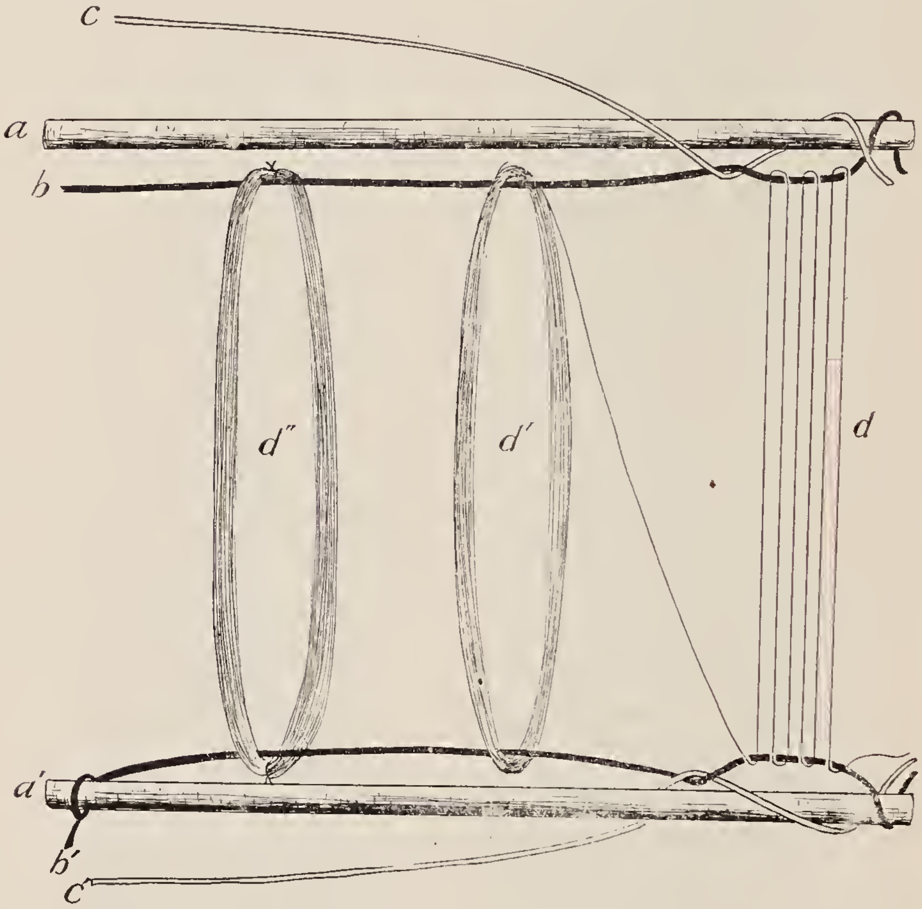

Fig. 40. Method of stretching Warps in the Loom. *a*, *a′*, loom bars; *b*. *b′*, loom strings; *c*, *c′*, tying string; *d*, *d′*, *d″*, warp skeins in different stages of adjustment between *a* and *a′*; *d*, warps in position for weaving; *d′*, partially used warp skein; *d″*, skein which has not yet been opened. The thread contained in these skeins is continuous.

In the small ribbon loom shown in the first paper, it will be recalled that the warps not stretched between the bars are drawn as though divided into skeins. This was done not only to show how tangles were prevented, but indicates the form in which warps were originally placed in the loom. This natural cohesion of approximately equal groups of warps is apparent in the two looms from Ica containing partially woven webs recently added to the collection (Fig. 10).

Drawing in warps is a very important part of weaving. These yarns must all be in place before the first weft is inserted. They form, as it were, the skeleton on which the fabric is built. The rules of good texture require that each square inch of web contains the same number of warp and weft as every other in the same web similarly decorated. It is therefore of prime necessity that the yarns which may not be either increased or diminished in number, nor moved in relative position, should be placed in correct division and order at first. If a single warp were out of place and crossed its followers, good weaving would be impossible.

There is also the matter of tension to be considered. The strain must be distributed equally on each end. This is not only to prevent breakage in weaving, but to insure good even cloth. A loose end would cause a pucker or a soft spot in the texture.

Therefore, the explanation of the skeins is as follows. Yarn intended for warp was looped over the sticks, probably thrust in the ground. The distance between them was the length of the web into which they were to be incorporated. As small amounts were thus treated, they were secured with string at the ends (Figs. 39 and 40). In this way the proper sequence was maintained and tangles were avoided. When sufficient of these hanks were formed, they were slipped over the loom string or bar. The skeins were thus treated in the order in which they were formed, each skein placed at a certain distance from its neighbor. Then the first skein was straightened on the portion of the loom it was intended to occupy. The small number of ends in each such unit, was easily arranged by the eye and hand of the weaver. The individual loops were placed on the loom in the same order as they had been wound on the ground stakes.

This orderly sequence was followed through the whole number of skeins, which for convenience, we call a warp chain. First the skeins were placed in the loom in the order in which they were formed; next each loop containing two warps was arranged in the order it was wound. It may be well to call attention to the fact that the warp in these fabrics is in reality not a collection of independent threads but a continuous length of yarn. At both ends of the web it loops back. In many fabrics which had loom strings, these loops can be plainly seen. Where loom bars were larger and left too long loops, many devices of weaving and darning were used to cover them up. Indeed, the effort to conceal these loops and protect them from wear was the impulse which directed the ornamental fringes and borders.

DISTRIBUTION OF TECHNIQUES.

There is a strong family resemblance between the textiles from the different centers of population of old Peru. The same fibers, practically the same color combinations and similar excellence in spinning, are characteristic of all the fabrics. However, there are certain minor details of design, varying degrees of excellence and a few apparently individual techniques, peculiar to the different localities. The collections in the possession of the Museum cover a large geographical area and are perhaps the most comprehensive in the world. Careful analysis and comparison of such comprehensive data should form an excellent basis for establishing the distribution of textile skill in this land. It seems unlikely that any really distinct weaves or fibers or designs peculiar to these ancient peoples should not be represented in this great amount of material. Still this possibility must be taken into account, and perhaps minor details may be modified by specimens in other museums, or among those yet to be discovered in Peru. Mr. C. W. Mead has given unsparingly of his time and knowledge to aid the writer in the technical examination of the Museum's great collection of cloth. It seems unlikely that anything of importance has eluded this investigator, still many interesting weaves were discovered almost by accident. For example, the important find of pile knot fabric resulted from an idle curiosity on the writer's part to learn the contents of a paper parcel, and in the two recent Juilliard collections distinct gauze weaves were revealed. It is therefore within the bourne of the possible that some interesting details may have eluded the search even in the Museum's collection. With full allowance for these exceptions it must be admitted that deductions made from so extensive a collection as the Museum's should be reasonably accurate.

The ancient centers of civilization adjacent to the modern city of Lima, were the most advanced in textile skill. Most of the finest pieces come from the localities of Ancon, Surco, Luriu, and Pachacamac. These places reflected the influence of the great Tiahuanaco. A comparison with the three Inca pieces, one of which was found in a stone chest on the Island of Titicaca indicates that even at the time of their weaving, the craft had degenerated from the ancient standard. There is perhaps too little material from the Inca period to establish this comparison, but the ponchos above referred to are so well known that it is justifiable to assume that if any other collection possessed pieces appreciably finer it would be a matter of record. The degeneracy is apparent in artistic merit as in technical excellence. The wonderful simplicity of geometric art typical of the best work of the ancients, is here replaced by grotesque realism and a general lack of design balance. The colors, excellent in themselves, fall somewhat short of the perfection of the older pieces.

The artistic superiority of the Tiahuanaco school is evident when we compare it with the contemporaneous production of Nazca and Ica. In these later places very skilful, and at times original, technical processes were applied in creating symbolical figures, in which an attention to supposedly important detail, has somewhat detracted from the undoubted artistic merit of the color harmonies. In other words, their art is overshadowed by superstitious veneration for certain grotesque figures and the concept of beauty of pure form is lacking or rather in a nascent period. The line of demarkation between the two schools is by no means absolute for in the fabrics of the Tiahuanacan area occur symbolical delineations and in those from the deserts of Nazca and Ica are many in which pure geometric figures predominate. Yet the tendency towards emancipation from the influence of superstition is much the stronger in the former school and coupled with a marked spinning and weaving superiority established this area as the one in which textile skill reached its highest development.

Under the notes on the separate development of Ica and Nazca, will be discussed the individual techniques in which these places excelled. These exceptions by no means weaken the general theory and are no more than the expected results of a wide distribution of skill in a particular art.

The Museum's collection is very rich in examples of the tapestries of the different areas. A careful examination resulted in the following analyses.

Finest plain tapestry, B-1225, count 44, three-ply cotton warp and 280 two-ply vicuña weft. Location, Surco.

Finest figured tapestry, B-8536, 44 three-ply cotton warp and 200–220 two-ply vicuña weft. Location, Pachacamac.

Finest all cotton tapestry, 40 three-ply warp and 180, two-ply dyed cotton weft. This piece was very difficult to count because there is a dense nap on the surface, due perhaps to some form of teasing. The design is simple weft stripes. It comes from Nazca.

Finest tapestry in which wefts interlock at every change of color (Fig. 5), count 32 cotton warp and 84 two-ply vicuña weft. The warp runs double but for the weaving count, each pair has been treated as a single end. They are single-ply cotton and extremely fine. Location, Nazca.

This type of weave only occurs in the fabrics coming from Nazca and Ica. Perhaps the idea was suggested by the interlocking wefts universally used to close openings in tapestry. It may also be added that as far as I have observed, no all cotton tapestries occur in the vicinity of Lima.

The counts of the three Inca ponchos found in a stone chest on the Island of Titicaca are as follows: —

B-1500, 24 three-ply cotton warps and 112 two-ply vicuña weft.

B-1504, 36 warps and 138 weft.

B-1505, 40 warp and 142 weft.

One of these ponchos has been compared with the fine artistic web from old Tiahuanaco in the tapestry chapter.

The finest example of bobbin-weave is the decorative stripe in B-1225. This piece has been discussed at length under that heading.

The two examples of pile knot fabrics come from Pachacamac. B-813 is a beautiful light weight embroidered veil 28 by 28, single-ply 250 cotton, came from the same place as also did the only examples of maguey fiber webs (1-993). The counts are as follows, 60 warps, 36 weft, 88 warp, 40 weft, both two-ply maguey.

The finest example of double cloth, B-4660, was from Pachacamac. As this fabric was described in the chapter on double cloth it is only necessary to repeat that it contains 96 warp and 96 weft in each square inch.

The finest plain weave comes from Paraiso, count 112 two-ply warp by 48 two-ply weft, both cotton. B-5449, referred to under mechanical design, is the best specimen of warp stripe and comes from Ancon. Its count is 104 two-ply dyed cotton warp and 34 two-ply undyed cotton weft.

Few examples of tie dyeing occur, perhaps too few to make a comparison but the finest in the collection at least is B-4062. The count of this is by no means remarkable, 44 warp by 40 weft single-ply cotton, but the fabric is a very fine example of light crêpe and the dyed pattern most effective. It was found at San Isidro de Sayan.

Certain comparisons have been purposely omitted from this list. Some fabrics were so nearly alike as to offer no sufficient basis and others occurring only in Nazca and Ica will now be discussed under those heads.

The collections from Nazca and Ica are recent additions to the Museum, purchased by Mr. A. D. Juilliard. The brief list of the techniques does scant justice to the value of these gifts. However, the points of technical interest have been considered under their separate headings and a view of the actual fabrics alone can furnish a proper idea of their beauty. The following weaves occur in Nazca.

In the Nazca collection are tapestry, bobbin-weave, painted cloth, brocade, interlocking weft tapestry, embroidery, and the only examples of twilling found in all the collections. In this collection are two very interesting ponchos of rough cotton ornamented at the throat and border by embroidered bands of a species of chain stitch (Fig. 16). The technique is suggestive of the rare old Moorish embroidered carpets. These pieces are remarkable for their wonderful dyes and many of their tapestries besides the cotton one above mentioned, fall little below the technical excellence of the pieces from around Lima. The most remarkable development is in brocading. Certain large shawls displayed in the Nazca case are completely covered with brocade figures.

Ica textiles bear a very close relationship to those of Nazca. Their technique includes all those of Nazca and a very remarkable application of embroidery to gauze fabrics. Besides these there are specimens of this technique on light and heavy weight which place this method of decoration as their principal mode of expression and perhaps as the finest type of the kind in all Peru. A method and a system which indicate many generations of creation and selection is very evident in their embroidery. This mode of expression has been relegated in our day to such a humble position that we lose sight of the fact that formerly it held a place in textile art second only to tapestry. In the possession of Mr. John Kimberly Munford is a very fine example of an old embroidered shawl from India. This web is covered so completely with needlework figures that the basic fabric is entirely hidden. There is, however, little if any method in the application of the decorative yarns and for that reason it is not such a fine technical example of this ancient craft as the Ica shawls which have been described and diagrammed in the chapter dealing with embroidery.

Perhaps some aid might be had in establishing the textile supremacy by a careful comparison of the yarn. This would be very unsatisfactory unless we could ascertain the natural advantages in the production of raw fiber peculiar to the different localities. Besides this, knowledge as to the existence of the cloisters and their influences on the craft would be desirable. From the available evidence, including the comparisons of the finest specimens, it may be said that the southern districts excelled in this as well as most of the other branches of textiles.

LITERATURE.

It is to be regretted that there exists so little technical writing on the general subject of hand spinning and weaving. Most writers dealing with these subjects naturally pay more attention to the historical and artistic qualities of the fabrics than to their purely mechanical qualities. The lack is particularly evident in the case of Peruvian textiles. To the early Spanish writers there was nothing novel or interesting in hand spinning or weaving. It was in the direct course of nature, just what they had seen every day at home. Slight differences of technique, so interesting to textile students, naturally made little impression on their minds. It must in fairness be admitted that the rich coloring and delicate texture of the actual fabrics were far from a matter of indifference to them or to the Spaniards who stayed at home. But their natural and commendable admiration for these handsome fabrics did not lead to a careful inquiry into the process of manufacture.

The careful German scientists have contributed two most excellent works on the woven material, but here as elsewhere the technical or rather textile problems, were either disregarded or relegated to the background. A work by Weiner in French entitled "Pérou et Bolivie" contains some fabric illustrations. By far the most careful work from a technical standpoint appears in an all too brief monograph by the learned Dr. W. H. Holmes entitled "Textile Fabrics of Ancient Peru" (Bull. 7, Bureau of Ethnology 1889). The only exception to be taken to this excellent paper is a slight confusion in the few textile terms and the lack of textile terminology. In other words, the writer approached the subject as a trained scientist, seeing clearly and writing as clearly what he saw; but naturally unfamiliar with the craft of weaving. Nothing could be further from the writer's purpose than to criticise so fine a work and the following remarks are intended merely to clarify Dr. Holmes' work for textile readers.

On page 7 appears the sentence: "No looms have been discovered," but almost in the next sentence a frame to stretch the warps is mentioned. Obviously, what is meant is that no complicated machine for weaving appears among the relics of Peru. The comparison with Coptic fabric at the top of the same page is in regard to tapestry, as the Copts had no such extensive technique as the ancient Peruvians.

On page 8, fig. 3 are illustrated a number of textile implements. It is not necessary to go into the matter at great length since the subject was treated in the first paper of the series. H is a weave dagger, L a weave sword, K and I, doubler spindles. The object marked E is not among the numerous relics in the Museum's collection. From its similarity to the bobbins used in modern tapestry weaving, I should say it was a weft implement. Its diameter would prevent it from being used in the weaving of the finest Peruvian webs. It may have been employed in the manufacture of the coarser fabrics.

On page 12, the opinion is expressed that tapestry figures were woven separately and then the intervening spaces filled in. Such faulty method of weaving is indulged in by the Navajo. The result is that two sets of weft woven in at different times do not run in exactly parallel lines. Anyone familiar with Navajo blankets will recall the stress lines appearing in these otherwise excellent fabrics. The best Peruvian tapestries show no such unevenness. There appears to be little doubt that no matter how varied the colors and figures might be, weaving was carried entirely across the width of the warp at each pick, and the fabric grew steadily and evenly upwards, the width of one weft at a time. An apparent exception to this rule is noted in tapestry weaving in the discussion of eccentric weft.

On page 13, the closing of the tapestry slits by the rough expedient of sewing is suggested. The different weaving tricks employed to close these openings or to prevent their appearance, have been fully discussed in the chapter on tapestry in this paper and in that on weaving in the first paper. Fig. 8 therefore represents some mending or maybe what is called interlocking weft.

The great care taken in the compilation of this paper is illustrated when we find the author describing exactly the technical nature of intricate techniques, the very names of which are apparently unfamiliar to him. On pages 16 and 17 are descriptions which must refer to double cloth, single-faced bobbin-weave (a species of Jacquard) and what may be brocade, if we merely change the text so as to read "weft" in one place instead of "warp" in the paragraph beginning "Hardly less interesting." Mention is made of the piled rope described in the present paper, also reference which can only mean embroidery or gauze or *buratto*, and lastly, a description of tie dyeing and cloth painting.

In Miss Mary Lois Kissell's admirable work on "Aboriginal American Weaving" (Transactions, The National Association of Cotton Manufacturers, vol. 88, p. 196) there is no reference to Peruvian weaving. However, the technique of weaving in Mexico and the Southwest, especially Pueblo weaves and looms is apparently very closely allied with those of Peru.

While perhaps not entirely pertinent to this paper, some brief discussion of the excellent monograph of Dr. Walter E. Roth on the textile arts of British Guiana may be of interest as showing one of the simplest forms of spinning cotton thread and also describing a very primitive loom. It will be observed that the entire processes are conducted without the aid of any implements except a spindle and a dish-like whorl of gourd, so light as to have no influence on the insertion of twist in yarn. No clearer idea can be given than the careful description of Dr. Roth: —

> After the cotton [*yaho-(t)udai-a* = cotton tree] has been picked, it is put in the sun to dry, but for not more than a day or two. It can then be stored in a *quake*, or basket, where it may remain for any length of time, provided it is not allowed to get wet. When about to be put to use, the *débris* is carefully picked out, and the whole teased, bit by bit. This teasing process is important. A very small handful is pinched up, teased out with the fingers, "smacked," so to speak, between the flats of the hands (Plate I, Fig. 1), and thus alternately teased and sharply squeezed into a very thin circular pat about 4 to 4½ inches in circumference. During the smacking process there is a slight simultaneous rotation at the wrists. A large number of such pats are placed one on top of the other, forming a pile or, rather, cylinder about 6 or 7 inches high. This cylinder is then pressed laterally, folded in its length, and gradually stretched. It is again folded in its length and similarly stretched, so as to form a soft pad about 2 feet long. Such teased cotton is called *yaho-abuni*. The spindle, or *Kiro-hodóri* (Fig. 2), is made of a tapering shank (*tu-dai-a*) up to 18 inches in length passed through two circular discs of "calabash" (*tuburado*), which form a guard (Fig. 3). As often as not, the spindle will be seen to have wound on it some cotton thread already manufactured, which will now be attached and worked into one extremity of the pad. This bit of manufactured thread, however, does not lead directly from the pad of raw material to the spindle, but indirectly, by means of an intervening loop, around the nick at the extremity of the shank. The purport of the loop will soon be recognized. On the other hand, if the spindle has no cotton already wound on it, the latter is replaced by any other conveniently sized twine similarly attached to its extremity by loop, and so on to the pad. At any rate, the long pad of teased cotton is twisted into a spiral, loosely at the distal extremity, but progressively tighter towards its proximal, which is again stretched previous to the whole being lightly wound around the forefinger and wrist (Fig. 4), its distal end hanging loosely from over the fore-arm. That portion of its proximal extremity between the two thumbs is now gradually and very carefully teased out and stretched, any untoward slipping being prevented by resting the third finger of the right hand upon the bent fore-finger of the left, which acts as a sort of fulcrum. On completion of the stretching, the amount and exact degree of which will depend upon the thickness of ultimate thread desired, the portion of cotton just stretched is rolled with the right hand, at the same time that the tip of the spindle is twirled in a reverse direction with the left (Plate II, Fig. 1). Not only does the loop, already referred to, ensure this rotary motion being imparted to the thread, but it also prevents the thread itself becoming shifted or untwisted from off the spindle, when the latter is now left to hang loosely up against the spinner's thigh. Some more of the pad is unwound from off the arm, its proximal end again carefully stretched, etc., the spiral condition of the whole being retained and aided

in the act of re-winding it on to the wrist, and the spindle again twirled. The whole process, indeed, consists of these three factors successively repeated — the winding of the pad, the stretching of that portion of it between the thumbs, and the twirling of the spindle. The retention and tightening up of the twist in the portion of thread already manufactured is, of course, due to the rolling of the two thumbs, during the twirling of the spindle, being in opposite directions. When a convenient length of thread, say 18 inches or a couple of feet, has been manufactured, it is rolled taut on to the spindle (Fig. 2), the spiral into which its constituent fibres have been twisted being in the direction opposite to that in which the completed thread is being rolled." [1]

To Dr. Roth's excellent paper we are further indebted for a diagram of a very primitive loom. It has generally been assumed that lease rods were indispensable parts of a loom. Mr. Luther Hooper states this in his work "Hand Loom Weaving" and the assertion is often met with in other technical works. The purpose served by these rods is twofold, they divide the warp into equal parts convenient for the formation of sheds and they place them in the same plane. When warps are strung over loom bars, they naturally are opposite, not parallel to each other. In order that the weft may be interlaced, it is necessary that some method may be found that will place them in position for the operation of weaving. Since something of this nature is required it has been too hastily assumed that no true looms existed without lease rods. The diagram, however, shows a primitive loom, containing neither loom lease or heald rods. The warps are so few per inch that it is not necessary to separate them into two groups to aid the formation of sheds and placing them parallel on one plane and at equal distance from each other is accomplished by the peculiar darning of weft. Here are two wefts picked in slack and between each pair of warps twisted about each other. It will be readily seen that this first pair of picks transformed a mere loop of string over two parallel bars at once into a workable warp capable of being the foundation of a coarse plain cloth by the simple interlacing of weft.

The weave sword is shown forming a shed of this set of warps. Whether it was then used as a batten to beat up the weft is not mentioned. Of course, beating up is only indispensable in the weaving of very compact fabrics; a loose weave suitable for a hammock or as a container for large objects could be woven without this process. This must consequently represent a very early form of loom, the loom of the Peruvians representing a very considerable advance. In this latter type (described in the first paper) appear loom strings which, because of their smaller diameter than the bars, lessen the need of lease. Heald rods are used to form sheds, and the weave dagger as an extra beating up implement. These apparently simple devices must have occasioned great improvements in the art of weaving and when properly considered are as remarkable as any of the later textile inventions.

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[1] Walter E. Roth, "Some Technological Notes from the Pomeroon District, British Guiana" Part II, (*Journal of the Royal Anthropological Institute*, Vol. XL, 1910).

Plate IX in the same paper illustrates a method of obtaining fiber from a leaf. By confining the leaf in a slip knot and sharply pulling it, the outside soft matter was removed, leaving the fiber partially prepared for spinning. Perhaps the maguey fiber of the ancient Peruvians was prepared in somewhat similar fashion. However, this could by no means account for the fine heckling, but may serve as an indication of some initial process.

In the Sixth Annual Report of the Bureau of Ethnology, Dr. W. H. Holmes has given some very interesting additional notes on certain Peruvian fabrics. They are considered in their relation to the general subject of textile art. On page 211, fig. 309, is a drawing of a fancy gauze which, strangely enough, very closely resembles one of the fabrics chosen for illustration in the chapter on gauze in the present paper. Fig. 310 represents a fabric containing gauze stripe. On page 212, fig. 311 appears a sketch of embroidery on a gauze basis or *buratto* forming a border on what appears to be a plain web of cloth. Fig. 314 is an arrangement of tassels, the technical nature of which cannot be determined from the illustration. Figs. 334–335 represent the face and reverse of a double cloth charm. It is a characteristic design of a fish and resembles the one selected for diagram in the section on this type of weave. Its nature is clearly shown in this splendid drawing. Fig. 342 is a tapestry representing a human form and certain other conventional figures and was taken from Reiss and Stübel's "The Necropolis of Ancon." Fig. 348 is described as embroidery on net; this may mean gauze. A fine example of the painted fabrics is given in Fig. 350. Fig. 349 described as embroidery, has much the appearance of brocade but of this it is impossible to be certain without examining the actual fabrics. A very fine example of painted cloth is given in Fig. 350. This completes the Peruvian textiles in this work. Their nature has been clearly illustrated in the text and their philosophical meaning discussed in a thoroughly scientific manner. This slight addition of terminology should make them thoroughly intelligible to the textile student as well as ethnologists.

CONCLUSION.

The reasonable limits of such a paper have permitted a brief discussion of a number of technical methods of design. Perhaps some superficial exception might be made to the assertion that there is no method of decorating a web of cloth, but has a representation in Peru, for as can be seen, no mention is made of roller printing. However, in Colombia, and occasionally in Peru, clay cylinders were used to print the human body, so it may fairly be said that even this principle was understood. It must also be borne in mind that such a generality applies to the philosophy rather than the details of the craft. However, lest by qualification the force of the truth be impaired, it can safely be asserted that no single people we know ever invented and perfected so many forms of textiles.

A brief outline of the weaves described in this paper will emphasize this fact and be sufficient excuse for the repetition.

- Tapestry
  - cotton warp, wool weft
  - all cotton
  - interlooping weft

In reality, each device for closing the slits might be treated as a separate technique.

- Embroidery
  - on very light material
  - on gauze
  - on loose weave
  - completely covering surface

- Brocade
  - self decorated
  - plain

- Gauze
  - plain
  - fancy
  - as basis for embroidery

Plain weaves, weft stripes, warp stripes, checks or ginghams, warp figures, and twills.

- Double cloth
  - Pile knot
    - in fabric
    - in ropes or cords
  - Lace
    - in bags
    - in fabric
  - Bobbin-weave
    - on one surface only
    - both surface and reverse
- Tie dyeing

The question naturally arises which of these techniques was the first, and in what order did the others follow? Only a very general idea can be given of such a subject and certain unknown conditions in different areas would modify details of perfect sequence in others. We must consider the different types with regard to technique rather than design, and passing from the simple to the complex, the conclusion will be reasonably accurate.

The earliest textiles were intended for ornamentation not as an aid to modesty nor as protection from the elements. The weave was a plain interlacing of warp and weft. The use of dyes was understood before textiles. Peoples very low in the cultural scale paint their bodies in grotesque figures. It is almost certain that some form of painting must have been applied to the first weaves. The early accounts of the crude textiles of the Eastern Indians speak of painting. Savages seldom leave undecorated any of their personal belongings.

Bags so closely resembling baskets, except that spun filaments take the place of reeds or grasses may have been the earliest form of weave. Belts also, appear in many tribes by no means famous for their weaving skill. Many tribes weave bags of excellent texture and apparently know nothing about other textiles. The fondness of savages for these two useful and ornamental forms of weaving may indicate the earliest use of weaving with spun thread.

Embroidery is perhaps the earliest mode of ornamenting a woven fabric by the use of decorative thread. The habit of sewing shells, teeth, and other small objects to fabrics would naturally suggest the use of the sewing yarn without the objects as a means of adding a touch of color. The first form of true woven design was unquestionably tapestry. The simplicity of this is so obvious that a child could understand it. It can be done on the most rudimentary loom neither lease rods nor healds being necessary. In fact, a form of tapestry could be made without even the batten or weave sword. Examples of peoples such as the Navajo and Chilkat, familiar with no other textiles, with the possible exception of warp decorated belts among the former, who weave excellent tapestries, are not wanting to emphasize this simplicity.

Both embroidery and tapestry are very ancient, local conditions determining priority in certain areas. In Peru both forms reached a very high development. In different geographical areas one or the other form predominates. The fact that embroidery occasionally follows the mechanical limitations of tapestry figures with a fidelity not required by its more facile technique does not indicate that tapestry was first, but merely reflects the predominating influence of textile ornamentation.

The next logical development would be the application of the colored yarns to mechanical design (Fig. 37). The introduction of heald rods as shedding devices would hasten this technique. The use of two or more colors of warp and weft would, at a much later period, suggest the combination of the same colors of warp and weft in double cloth. In fact, some Peruvian webs are part stripes and checks and then the fabric changes into a double cloth with only the addition of an extra weft.

In what sequence, gauze, pile knot, and tie-dyeing appeared there is no way of estimating. The mere predominance of one technique might only indicate a preference, and this preference might be expressed for the latest invention. The scarcity of the others might mean degeneracy as easily as incipiency. However, of these three, gauze is the most common and most highly developed.

Brocade and bobbin-weave are closely allied to embroidery and probably are of later development. Before brocade could reach much vogue, textile skill must have reached a height which made the weaving of close even webs common. For without this basis, the brocade yarns could not be forced to the surface in beating up. Bobbin-weave is so often found and of such great excellence, that it is very difficult to assign it any but an early place in the history of textiles. It is also a common method of decorating baskets or mats. Yet, the great difficulty of applying this method to fabrics composed of fine spun threads and the amount of forethought required to produce design, seem to indicate that it was the fruit of centuries of textile experience.

Attention has been called to the similarity of Peruvian with Asiatic design figures. The general explanation has been that two races weaving fabrics for great periods of time must arrive at great similarity of figures even without the influence of cultural relationship. The fact, however, that Egypt equally ancient, and for centuries using the same type of loom, achieves no such resemblance must somewhat weaken such a theory. In fact, Egypt practically never advanced in textiles from the simplest methods until the comparatively modern introduction of Coptic influence. Even though we cannot account for the similarity of design in South America and Asia, we must still admit that it exists to a remarkable degree.

There are certain forms of textiles that are practically universal, such as tapestry and embroidery. The appearance of these fabrics in widely separated parts of the globe can be of no significance. They are so simple and arise so spontaneously from the practice of weaving that independent development is not only possible but the natural thing to expect. It is a question, however, if a like easy explanation can be accepted for such complicated techniques as gauze, double cloth, and tie dyeing. Brocade and bobbin-weave are excluded from this discussion because the former is a natural development of embroidery and the latter is so common in basketry. Pile knot, however suggestive, is eliminated because the technical relation is scarcely as significant as is the mere surface appearance although it may be an interesting speculation to say that two techniques having as a result such similarities of appearance could not be totally unrelated, but such reasoning leads into too many pitfalls.

But the three mentioned fabrics and especially gauze and tie dyeing are at once so original in conception and so similar in both Asia and Peru as to force themselves into notice. Could the human mind have twice stumbled on such unique construction? Can this resemblance, so singularly emphasized by a strong artistic likeness, be merely an intellectual accident? Even admitting that many textile designs and processes were simply copied from the more primitive form of basketry, does not this admission merely change the issue from weaving to basketry?

When we look at the immense amount of literature devoted to Asiatic rugs and to European tapestry, two rather simple technical expressions of the weaver's art, it must be evident how little can be hoped for from so brief a paper dealing with so many and so complex forms as this. We have been so long accustomed to regard Asia as the fountain head of textile knowledge that perhaps sufficient attention has not been drawn to the skill and science displayed in our own hemisphere. This is to be regretted, since the ancient inhabitants of this half of the globe developed a technique and an art which more than repays the effort necessary to its comprehension. While Peru stands far in advance of any other race, still many peoples such as the Hopi, and Huichol, were very excellent craftsmen. The weaving of fabrics by machinery is a thing of but yesterday, the art of the hand loom reaches back into an antiquity almost contemporaneous with the antiquity of the human race. A thorough study and proper appreciation of the knowledge stored for centuries in the ancient graves cannot fail to be of immense value to all interested in the development of the modern industry. Painters, architects, and engineers are not ashamed to learn from the ancients, surely weavers should have no scruples.

Weaving is the most ancient of the great arts. It is still, next to agriculture, the largest industry in the world. At the very dawn of man's history it appears, and has continued down to our own time, a thing inseparable from true culture. Man's ideas of beauty have been fostered and gratified by its products, his ingenuity has been exercised and his comfort enhanced by its agency. From the rough fish weirs to the most elaborate baskets, from the coarser fabrics of flax to the gossamer webs of cotton and silk, it has sustained and beautified his life from the night of history to the latest passing hour; it is the veritable nurse of civilization.

Peru's part in the world's textile development, had her skill and knowledge been available at the proper time, would have been immense. The accidents of history which either prevented her taking this part or prevents us from knowing that this glory is justly hers, cannot detract from the proof of her intellectual greatness, predicated by such great development in so intricate an art. Her isolation forced her to travel the long road alone. From the roughest wattling, the mere interlacing of twigs and stakes, up to the finest of woven webs, composed of the most delicate filaments human hands ever formed, each painful step was directed solely by her native genius. Surely unless all records of human progress have been incorrectly appraised, this must have taken immense eras of time. These beautiful and faultless examples of this prehistoric art must as certainly point to great antiquity as the most venerable relics of Egypt or Asia.

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